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VIEWS, NEWS AND INTERVIEWS.

A man on horseback has been riding through Jamaica village on Long Island, in the night, trying to destroy the electric light plant that lights the village. He was seen on the night of June 25 on Liberty avenue, cross-connecting the wires. On June 26 he was seen riding hastily in the region of South street, and afterwards near Hollis. He dismounts from his horse, climbs an electric light pole with the agility of a cat, and as soon as his work is accomplished he mounts his horse again and is off. Strenuous efforts are making to apprehend the marauder.

"Considerable advances have been made in the art of electrocuting criminals since Kemmler was killed," remarked a well-informed electrical engineer. "About 1,700 volts is the maximum alternating current now used. A contact of one second or even less is sufficient to destroy the life of the criminal, and then the current is slacked down to 300 or 400 volts, which is maintained until the doctors order the current shut off. Thus is avoided the unpleasant muscular contraction peculiar to death by electricity. The gradual slacking of the current maintains the muscles in a tense state, and prevents the limp appearance presented by the prisoner heretofore. There is no doubt that the most minute contact of 1,700 volts causes instant death. All other phenomena are due to reflex action after death. I understand that a new and improved apparatus for the electrocution of criminals is now being prepared for use in New York State."

One of the most useful agricultural appliances that has been devised for the clearing of new land is the root puller, and many years of labor have been saved in this country by its adoption. The record for both efficiency and economy is likely to be broken by a root grubber worked by electricity, which has just been brought out in England. On account of the advantage to be gained from the water power, a manufacturer has established his works on the banks of the River Darenth, in Kent. When first acquired, the works consisted of a ruinous and dilapidated old flour mill, but it took only a short time to make them remunerative. The water gives the power for driving a generating plant, as well as many other machines connected with the factory, which is lit by electric light. A second generator is used for experiments in electrical plowing, threshing, etc. The owner of the factory is an enthusiast in these matters, and thinks electrical agriculture has a great future before it. A third dynamo is used for generating current for supplying the grubbing apparatus at the top of a hill two miles distant. The current is taken by overhead wires on telegraph poles to the motor on the grubber carriage. At the top of the hill several acres have been already grubbed. The ground is being cleared for the purpose of constructing one of a series of large forts for the protection of London.

The Charges Against Ex-Commissioner of Patents Simonds.

The investigation of the charges of gross misconduct and connivance in the procurement of copies of Drawbaugh telephone files made by Messrs. Church & Church against Messrs. Foster & Freeman, ex-Commissioner of Patents Wm. E. Simonds and Mr. Bennett, the chief clerk of the office, consumed three whole days of last week. Commissioner Seymour presided at the investigation with the assistance and counsel of Assistant Commissioner Fisher. Mr. Melville Church appeared in the unique capacity of a self-appointed prosecuting attorney who, after having prepared and published indictments against the persons named, came into court to request the judge to hunt up some evidence to sustain the charges. It soon appeared that he had no case. He had no evidence of his own to produce, except the private accounts of some typewriters, in which Foster & Freeman were charged for copying certain Drawbaugh files which were not specified. The manner in which Church is said to have got access to his neighbors' accounts does not exactly indicate "gross misconduct," but is not considered entirely professional.

The greater portion of the time spent in the investigation was taken up in a labored, wearisome examination of Patent Office employés by Mr. Church, whose questioning brought out long statements explanatory of the routine work of their divisions, without throwing much light on the subject of the inquiry. All the persons against whom charges were made were present with their counsel and submitted statements which fully explained their action in the matter, and clearly showed that nothing contrary to law and the practice of the office had been done. The American Bell Telephone Company and Mr. Simonds produced the copies of files which they had obtained and which proved to embrace nothing to which they were not entitled.

Before the examination closed Mr. Church stated that the testimony showed that Mr. Foster (of the firm of Foster & Freeman) had no connection with the matter and knew nothing about it, and he withdrew all charges against him. The commissioner, without anticipating his formal decision, stated that there was nothing to show any misconduct on the part of Mr. Freeman and his firm was practically acquitted. It appeared that Chief Clerk Bennett had simply followed the long-established regulations of the office and obeyed the orders of his superiors. The statement of Ex-Commissioner Simonds was candid and clear and made a very plain and simple matter of what had been magnified and shrouded in mystery.

Before Church & Church promulgated their newspaper charges, Commissioner Seymour, whose attention had been called to the subject by a letter from that firm, had commenced a private investigation of the matter and, if he had been allowed to proceed, the affair could readily have been explained and disposed of.

The plain story of the alleged scandal appears to be about as follows:

Readers of the ELECTRICAL REVIEW will remember that Commissioner Simonds was severely criticised at the time the patent for the Berliner transmitter was issued to the Bell Company, in 1891, and the charge was made that Berliner's application was intentionally delayed in the office for some eight or nine years. What Mr. Simonds could have had to do with delaying the business of the office before he was connected with it was never explained. The issue of the Berliner patent was for a long time prevented by some of the Drawbaugh cases, which had to be disposed of first, and Mr. Simonds simply acted on the case as it came to him in the regular course of the business of the office.

Not long after the Berliner patent was issued somebody in the Department of Justice, probably actuated by the lingering animosities of the notorious Pan-Electric telephone case, started an attempt to have the government cancel the Berliner patent, and the attorney general sent the papers in the case to the Secretary of the Interior for his opinion as to the propriety of the proceeding. By direction of the Secretary of the Interior, Commissioner Simonds wrote a reply in which he expressed the opinion that the Berliner patent could not lawfully be cancelled. This reply aroused a great deal of feeling, and there were intimations that the attempt to cancel the patent would include an attack on Mr. Simonds for issuing it. Very naturally Mr. Simonds deemed it prudent to prepare for such an attack and, with the permission and approval of the Secretary of the Interior, and with the full knowledge of a large number of the subordinate officials of the Patent Office, procured certified copies of certain papers in the official files, none of which, however, was considered confidential. When the Department of Justice commenced its suit against the American Bell Telephone Company, it requested certified copies of an immense number of papers relating to the inventions of Bell, Edison, Berliner, Drawbaugh, and in fact nearly everything included in the telephonic history as recorded in the Patent Office. Subsequently the Bell Company made an application for certified copies of certain papers necessary to its defense, and Mr. Simonds directed the custodians of the records to have carbon copies of these papers made for him. It was shown at the investigation that copying of papers for the Department of Justice has been going on under the present administration and, on the general principle that the government has a right to examine all records in its possession, it is not at all certain that the Department of Justice has been confined to files accessible to the Bell Company. In some cases 10 copies of the files were made for the Department of Justice. What is to become of all these private papers will be an interesting question for the future.

The application of the American Bell Telephone Company was made on the official form and accompanied with the proper affidavit, by Mr. W. W. Swan, who, on filing it, stated to the commissioner that, while he believed he had asked for nothing to which the company was not legally entitled, he had included one paper about which there might be some question and suggested that careful attention be given to that point. The commissioner decided that the paper designated could not be given out. The others were forwarded direct to the Bell Company, and Foster & Freeman simply paid the copyist's bill.

After the evidence was all in, the case was postponed to July 6, when arguments will be presented. The general belief is that none of the charges have been sustained and that the prosecutors have suffered more damage than any one else.

The question which Commissioner Seymour will have to decide is principally one of departmental ethics. G. C. M.

Steam Engine Efficiency—Its Possibilities and Limitations.

BY WM. H. BRYAN, MEMBER ENGINEERS' CLUB, OF ST. LOUIS.

Among the steam using public there is not a little uncertainty as to just what is meant by steam engine efficiency. And many engineers, who, in the multiplicity of their duties in other directions have found little or no time for research in this field, are frequently mystified. We are told, for instance, that the exhaust should always be condensed; that engines using steam expansively are better than engines with throttling governors; that double compound engines are better than single cylinder; that triple compound engines are still better; and that if we desire to reach the highest efficiency we must use the quadruple compound engine.

These statements come from the highest authorities, who point to many instances of success; and yet we need not go far to find cases where results quite the contrary have been found—where the addition of a condenser has resulted in an increase in the coal bill; the cut-off engine has proved more wasteful than the throttling engine; the single cylinder than any form of multiple cylinder. So signal have been the failures in some cases, that the business man, judging efficiency solely from the standpoint of dollars and cents, has felt called upon to denounce the whole idea of higher economy as laid down by the authorities, and all the improved appliances thereto. And thus another failure is recorded, and the theoretical is again claimed to be at variance with the practical.

I have had occasion before this to discuss the relations between theory and practice (see *Age of Steel* of June 25, 1892), and shall not now take them up. Suffice it to say, that when such discrepancies appear we have either made a wrong application of a true theory, or we have selected a theory which in no way fits the case in hand.

I bring to you this evening no startling or newly developed theories, no unexpected or disappointing results from practice. I cannot even claim the merit of originality or novelty for what I have to say, for the facts are all of record, and were laid down by master minds, whose invaluable researches have made our present knowledge possible. I shall feel amply rewarded if I succeed in calling serious attention to a few principles underlying the success of the commercial steam engine, pointing out its strong features and its drawbacks, even though I may not indicate clearly the proper path to follow in any given case.

It is necessary to consider the steam engine in two aspects—the ideal and the real. The former is the perfect engine, the thermodynamic engine, the engine of the philosophers, of the Carnot cycle. It does not exist, never has existed, and never will exist. It has no standing in the world of practical mechanics, but it has, nevertheless, a place of great importance in the world of the student. It is this engine which tells us what is before us, and which sets a limit to our ambitions—a limit which we shall never reach and which is still far beyond us, but which warrants our most earnest efforts in drawing nearer to it.

The conception of the ideal or perfect engine is simple. Steam considered as perfect gas expands, as many times as we choose, in a single perfect cylinder, the walls of which neither absorb nor give out heat. We measure its losses by the difference between the

temperatures T_1 T_2, between which it works, and its efficiency by $\frac{T_1 - T_2}{T_1}$ measured in each case from the absolute zero, 461 degrees below the zero of Fahrenheit. An efficiency of unity is therefore obtainable only by discharging the exhaust at the absolute zero of temperature, a condition now manifestly impossible, and likely always to remain so.

We see, then, that the perfect steam engine itself is of low efficiency, due to the comparatively narrow limits of temperature within which we must work. It is possible, however, to clearly determine the efficiency of a perfect heat engine working between the limits of temperature now common in practice. Cotterill, in his admirable work on "The Steam Engine Considered as a Heat Engine," states them as follows:

Type of Engine.	Superior Limit.		Inferior Limit.		Lbs. Steam Per I. H. P. per hour.	Efficiency.
	Pressure Abs.	Temps F.	Pressure Abs.	Temps F.		
Non-Condensing.....	250	401	14.7	212	11.4	.219
	160	363	"	"	13.8	.183
	120	341	"	"	15.8	.161
	80	312	"	"	19.9	.130
	55	287	"	"	26.0	.100
Condensing.....	120	341	0	100	7.5	.299
	95	324	"	"	8.1	.285
	60	293	"	"	9.0	.256
	30	250	"	"	11.2	.211
	20	288	"	"	12.8	.186

From which it appears that the perfect engine, with condenser, running with 105 pounds gauge pressure, requires 7½ pounds of steam per horse power per hour; and that, even then, its efficiency is less than 30 per cent. In other words, if it were possible to transform all the heat units in the steam into useful work, but 2¼ pounds of steam per horse-power per hour would be required.

It is evident, therefore, from a consideration of the theory of the steam engine, that there are drawbacks inherent in this form of motor which set a definite limit to its economy. This has led to a wide investigation in other fields for a more efficient motor—not without some promise of success—but the many advantages and conveniences of the steam engine will, in all probability, keep it with us for many years.

Let us now take up the actual commercial steam engine of to-day.

It has many frailties. It lacks as much of attaining the efficiency of the perfect engine as the latter does of fully utilizing the heat units which, if the expression may be allowed, pass through its fingers. The apparently simple requirements of the perfect engine are impossible of attainment. Steam is not a perfect gas when saturated, and only approximately so when superheated. The number of expansions possible in practice is limited. High initial temperatures and pressures mean increase in first cost, and cost of maintenance, greater liability to accident and greater losses through leakage. The limit in the other direction is even more rigidly fixed. A condenser temperature of 100 degrees F. is even lower than can ordinarily be obtained. It is true that Du Tremblay lowered the final temperature to 60 degrees by the addition of an ether engine, working between the temperature of exhaust steam and that of the condensation of ether, by which means he secured an efficiency of 35 per cent. for the perfect engine. This plan, however, has not come into general use, and probably never will, on account of the practical difficulties connected with the use of ether.

Furthermore, a large number of expansions in a single cylinder mean a very large vessel, very rigid and heavy construction, and serious losses, due to internal condensation—the comparatively cold walls of the cylinder robbing the entering steam of a large number of its heat units, and giving them back near the end of the stroke, too late for transformation into useful work, and where they are swept out by the exhaust.

These difficulties have led to the development of the multiple-cylinder engine, in which the steam is worked successively through a number of cylinders in series. This has resulted in a better distribution of the strains, and, as Professor Thurston has recently pointed out so clearly, confines the losses to those of a single cylinder working between comparatively narrow limits of temperature. The heat units, restored in the latter part of the stroke, instead of being swept away unused, are available for efficient service in the next succeeding cylinder.

Practical difficulties are soon encountered here, however. Multiple cylinders mean greatly increased first cost for the same capacity, greater complication of parts and, as a result, more liability to derangement, besides requiring a higher and better paid class of skilled labor in their operation. In addition, there is an increased cost for space and for foundations.

The real steam engine, whether simple or multiple cylinder, is subject to still further losses. Piston speeds are confined within narrow limits; clearance spaces may be reduced, but cannot be wholly done away with; valve gears are slow in acting and imperfect; valves themselves, as well as pistons, leak; and more or less heat is lost through conduction and radiation.

And, in practice, the losses do not stop here. No engine, however well constructed and designed, ever has perfect care. Leaks occur and grow. Adjustments become less and less accurate. Steam is frequently wet. Steam passages are uncovered, and sometimes they are badly cramped. Worst of all, the work is frequently far different from that for which the engine was designed. An underload is even more fatal to good economy than an overload, but it is frequently unavoidable, as power must be provided for prospective, as well as present requirements. Furthermore, it is frequently necessary that an engine be sufficiently large to handle sudden and severe overloads, as in rolling mill and electric railway service. Here the maximum is sometimes many times the average load, so that conditions favorable to high steam efficiency are impossible of attainment.

There is one other loss which cannot be wholly overlooked in this discussion—that of the friction of the engine itself—which reduces the indicated horse-power to that known as "net effective," capable of delivery to the work in hand. This is a question wholly of design, construction and care in operating, and is largely increased by the complication of parts necessary in multiple-cylinder or other types of high efficiency engines.

I believe I need say no more to convince you that the conscientious engineer, who would select the best engine for any given work, has a problem of no mean proportions on his hands. It is half the battle to be able to definitely and clearly state the conditions, but this is often difficult and sometimes impossible. The question comes to us in a wide variety of forms. We cannot always determine in advance what our load may be; and if we could, it is more difficult in many lines of work to determine the maximum and minimum requirements, and to give them their proper relative value as compared with the average load.

Let us assume, however, that we are able to simplify the problem to that of selecting or designing the type of engine best adapted for a given constant load of specified duration. This leaves us free to select the initial and terminal pressures and temperatures; the general type of engine, whether simple or multiple cylinder, condensing or non condensing; piston and rotative speed; and whether we shall jacket the cylinders, and use saturated or superheated steam.

First, it will be interesting to make some comparisons of existing engines of well-known types, to determine what efficiency is already attainable in practice under the most favorable conditions.

EFFICIENCY OF ACTUAL ENGINES.

No.	Type of Engine.	Superior Limit. Pressure Absolute.	Superior Limit. Temperature F.	Inferior Limit. Pressure Absolute.	Inferior Limit. Temperature F.	Steam lbs. per I. H. P. per hour. Ideal.	Steam lbs. per I. H. P. per hour. Actual.	Efficiencies. A.	Efficiencies. B.	Efficiencies. C.
1	Tr. Comp. Condensing.	140.	353.	1.5	115.	7.925	12.67	.183	.292	.636
2	Cr. Comp. Con.	140.	353.	1.8	109.	7.615	12.04	.176	.300	.588
3	Tr. Comp. Con.	113.	337.	1.7	115.	8.384	13.35	.176	.278	.632
4	Ver. Comp. Con.	117.	335.	1.7	115.	8.457	14.50	.159	.276	.577
5	Ver. Comp.	117.	335.	2.	126.	8.703	18.59	.124	.214	.580
6	Corliss S. C. C.	72.	303.	4.6	112.	9.289	18.59	.124	.214	.580
7	Corliss N. C.	80.	310.	15.9	216.	10.523	25.39	.102	.182	.709
8	Locomotive.	130.	347.	20.2	228.	17.574	26.86	.096	.174	.654
9	Loco ve Comp.	151.	356.	19.4	225.	15.381	20.86	.125	.169	.739
10	Slide Valve.	98.	322.	17.2	220.	19.849	32.34	.063	.103	.614

While this data is not as complete as I would like to have it, it is nevertheless worthy of study. The results given under the head of efficiencies are particularly interesting. Column A indicates the efficiency of the engine as regards the total heat units in the steam. Column B indicates the efficiency of a perfect heat engine working between the given limits of temperature. Column C represents the relative efficiency, that is to say, the ratio of the heat units utilized to those available within the limits of temperature between which the engine is working.

The efficiencies shown in column C are of special interest, as they indicate the extent to which each type of engine utilizes its opportunities as a heat engine. The steam consumption of the ideal engine, as shown in column 7, is the limit toward which we should continually draw nearer. The efficiencies in column C show how much our present engines lack of reaching perfection. It is not too much to expect that these efficiencies may be continually improved in time by improving types of engine, as the losses may all be termed preventable, at least in very large part.

Considered wholly as heat engines, the complicated "high efficiency" machines are less efficient than engines of simpler construction. This is as might be expected, on account of the fewer opportunities for leakages and other losses.

A curious fact is shown by test number 7. The ordinary single cylinder, non-condensing engine, which has a theoretical efficiency of less than half that of the triple expansion engine, appears in the present instance to have a relative efficiency very much greater.

No. 1 is the triple compound vertical condensing pumping engine of 15,000,000 gallons capacity daily, at the Harrison street pumping station, Chicago. The test was made by D. H. Fiend, assistant city engineer.

No. 2 is a horizontal triple compound condensing engine in the plant of the Narragansett Electric Lighting Company, Providence, R. I. This test was made by E. D. Leavitt.

No. 3 is a cross compound engine in the mills of the Richmond Manufacturing Company, Bristol, R. I. The test was made by Remington & Henthorn, engineers, Providence, R. I.

No. 4 is a tandem compound condensing engine in the works of the Plymouth Cordage Company, Plymouth, Mass. This test also was made by Mr. Leavitt.

No. 5 is a vertical compound condensing engine. All the above engines were built by the Edward P. Allis Company, Milwaukee.

Nos. 6 and 7 are from tests made in 1877 by John W. Hill on an 18x42 Harris Corliss, speeded 75, located in the flour mill of Gibson & Company, Indianapolis, Ind.

Nos. 8 and 9 are from Baldwin locomotives on the Baltimore and Ohio Railroad, the tests being made by George H. Barrus in 1890. No. 9 is the only authentic record I could find of a non-condensing compound engine, but I think the results fairly represent what may be secured from similar stationary engines.

No. 10 is from a well designed slide-valve engine, 40 horse-power, 9 x 15 6, speeded 195, tested at the Sixth Cincinnati Industrial Exposition in 1870, by John W. Hill, Isaac V. Holmes and J. F. Flagg. The results are undoubtedly much better than can be secured from the ordinary slide-valve engine, which rarely falls below 40 pounds steam per indicated horse-power hour. In fact, the results given may be taken as fairly representative of the best high speed automatic cut-off engine practice of the present day.

High efficiency is evidently a question of cost, both in plant and skilled attendance. High duty engines, with the necessary high pressure boilers and pipe work, are expensive at first, and difficult to maintain. The problem then appears to be, not what is the highest efficiency possible, but how high an efficiency can we afford.

I shall not attempt to answer this question in detail. It is a complicated one, and can only be definitely settled by a special consideration of the peculiar features surrounding each case.

The important advantages to be gained by the use of high efficiency engines are:

First, reduced fuel bills; and, second, reduced first cost for boilers, with their settings, and the space they occupy, there being fewer of them required.

As the second consideration is usually much more than offset by the increased cost and space occupied by the engines, we may reduce the problem to that of the net saving in fuel and its value in dollars and cents. By the latter standard must all such problems be judged. The most ordinary slide-valve engine is amply efficient at the mouth of a coal pit, while in distant mountain regions, where fuel is very costly, the highest grade of multiple cylinder condensing engines are usually justified. This conclusion, however, must be modified in any particular case by the surroundings. Is water available at reasonable cost for condensing? Can skilled attendance be had? Is the engine of a complicated nature, liable to accident and difficult and expensive to repair? Is the load sufficiently large and constant to insure the results anticipated?

For variable loads the engine cannot reach as high an efficiency as with a constant load; and economy must frequently be made secondary to securing enough capacity for sudden and momentary overloads.

Professor Thurston gives the following table as representing the best practice, as applied to the total number of expansions desirable, and best number for each cylinder:

	Total.	Single.	Limit of Pressure.
Single cylinder.....	5	5	50
Single cylinder.....	6	6	60
Compound.....	9	3	90
Triple.....	27	3	270
Quadruple.....	81	3	810
Quintuple.....	243	3	2430

This does not accord entirely with western practice, where 80 pounds for single, 100 to 120 for compound, and 150 to 200 triple expansion, are thought to be about correct. I have not, however, been able to find any data warranting these figures.

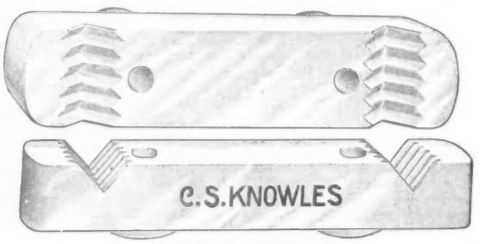
In fact the superior actual efficiency of the engine No. 7 over No. 1 in our table, may possibly be explained by the fact that the superior temperatures and pressures were entirely too low in the latter case.

The efficiency of pumping engines is measured in foot-pounds of work done by 100 pounds of coal burned. And in order to eliminate the question of the quality of the fuel and the efficiency of the boiler, an evaporation of ten to one is often assumed, so that the duty then becomes the number of foot-pounds of work done by the engine with 1,000 pounds of dry steam. In order to compare the efficiency of pumping engines with that of ordinary engines, I have deducted the following formula:

$$D = \frac{1980}{S} \text{ or, } S = \frac{1980}{D}$$

In which D is the duty as last defined above, and S the pounds water evaporated per horse-power per hour. It is sufficiently accurate for ordinary purposes to call the figures 2,000, which greatly facilitates carrying the formula in one's mind.

The formula as given is not strictly accurate, as the duty is always net useful work, while steam efficiency is usually measured per indicated horse-power. The former, in case of engine No. 1, in our table, was exactly 10 per cent. less than the latter. This loss is slightly greater than usual, however, on account of the necessarily complicated construction of the engine. It frequently falls to five per cent. with ordinary engines of good construction.



The Duggan Cleat.

The Duggan Cleat.

C. S. Knowles, of No. 7 Arch street, Boston, Mass., is just putting the new "Duggan" cleat on the market, an illustration of which is given herewith, and for which a number of valuable features are claimed.

It is a two part cleat, made of the best quality of porcelain, and both parts being identically the same, it saves any time and trouble of matching them by the wireman, any two pieces making a pair.

The slots through which the wires pass are ribbed in such a way as to prevent slipping, and it will clamp firmly any wire from No. 16 to 6, inclusive.

The simplicity of its construction enables it to compete successfully in price with anything now on the market, and it is made for either two or three wires, as desired.

The Louisville Electric Light Company, which is practically the Louisville Gas Company, is now building an addition to its already large plant at Fourteenth and Magazine streets, which is to cost $200,000. This is made necessary by the increased demand for electric lights and other electric appliances. The electric plant at Fourteenth and Magazine streets cost $450,000 two years ago, and so rapid has been the increase of demand for electric lights that the present facilities are inadequate. The city now uses 736 arc lights, and 250 more will be put in within a week or two. Altogether, the city will need between 1,100 and 1,200 lights to supply the places of the gas lamps.

A New System of Underground Electric Traction.

On last Suburban Day at Coney Island was given a most interesting trial of a new system of underground electric traction. The inventor of this, John J. Green, of Boonton, N. J., has recognized that the principal difficulty with most of the systems heretofore tried has been an undue leakage. Bare wires have generally been used in these conduits, but the inventor of this improvement has departed from this custom and employed lead covered insulated cable, bare at regular intervals, thus affording electrical contact with the car through ingenious contact boxes. Some years ago the Bentley & Knight system was tried in Cleveland, O., but this underground method was discontinued, due, it was claimed, to many serious mechanical difficulties. In this system all dangers from leakage are avoided, for only at the moment when the car is immediately over the contact points can the current have a chance to escape and thus ground the line.

FIG. 1.—TEMPORARY TRACK LAID AT CONEY ISLAND, EQUIPPED WITH THE GREEN UNDERGROUND SYSTEM.

The essential features consist of the contact boxes and the shoe or traveling contact brushes. The boxes, one of which is shown in Fig. 4, are placed to the right and left of the "shoe" along the line, so situated alternately that at any moment the "shoe" of the car is in contact with three boxes—*i. e.*, two negative and one positive, or two positive and one negative. This furnishes a continual supply of electricity to the motor, for by this means there is no period of time when the current is not available—an obvious necessity. The "shoe" device, shown in Fig. 6, may be likened to a cable grip, inasmuch as it travels in the conduit slot, but it receives current instead of holding the traveling cable. The arrangement for holding the shoe to the car truck is a simple double groove, out of which the shoe may easily slip should the car be derailed.

The shoe consists of two long strips of spring brass, insulated from each other by hemi-cylindrical hard rubber pieces. These strips slide in grooves so as to accommodate the "shoe" to short curves, the bending being produced by the guides which slide in the slot, thus giving direction to the curve. The strips of brass do not extend the entire length of the "shoe," but a little leeway, of about six inches of hard wood on each end of the "shoe," allows a breaking of the circuit on the "shoe" instead of in the boxes. This provision prevents arcing inside of the boxes and consequent destruction of the internal contact points.

The contact boxes are so constructed that the current is only delivered when the "shoe" presses against the contact points. Inside of the box, the cable is stripped bare and the strands are held by brass clamps, which in turn connect with two contact posts imbedded in solid paraffine up to their base; and above that paraffine oil surrounds the posts to prevent leakage. Playing between these contact posts is a spring brush held rigidly to the swinging arm above the box. Electrical connection between this brush and the cap upon the end of the arm is maintained by a spring of copper strip, which serves the double purpose of carrying the current and acting as a spring to prevent the arm from working as a toggle joint, when the shoe strikes it, and thus breaking the box.

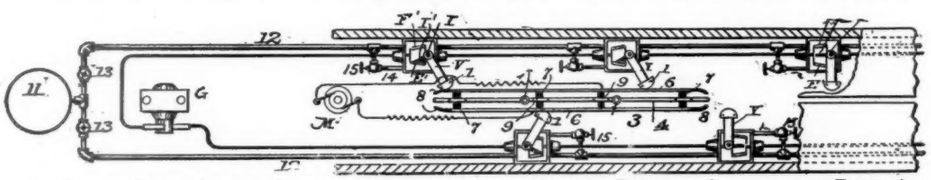


FIG. 2.—PLAN OF TRACK, SHOWING CONTACT BOXES AND "SHOE" IN POSITION RECEIVING CURRENT FROM THREE ARMS.

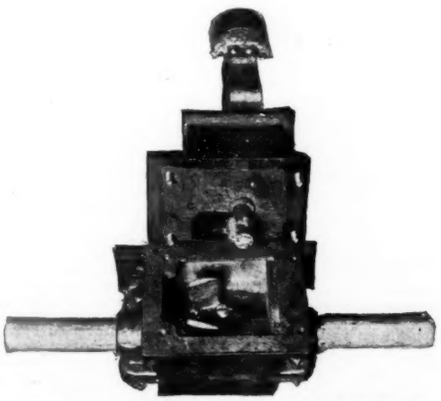


FIG. 4.—VIEW OF CONTACT BOX, SHOWING CONTACT POSTS ATTACHED TO BARED CABLE.

As the box stands, no electrical contact is maintained between the cable and the cap. It is only when the shoe strikes the cap that the arm swings, and presses the brush against either of the contact posts, depending on the direction in which the car is going.

All contingencies seem to have been foreseen; the paraffine oil, together with the block of paraffined wood above the top box, is supposed to be a sufficient insulator to prevent all leakage.

The caps, which are practically the only wearing parts of the boxes, are made so as to be easily and cheaply renewed.

The electrician of the company, Mr. Stetson, claims for this system simplicity of construction and operation and freedom from leakage even when the conduit is wholly or partly filled with mud or water.

The cost of construction, it is claimed, outside of the expense of the conduit, is no more than that of a trolley line.

The temporary track now laid at Coney Island is about one-quarter of a mile in length, and is sufficient for a very fair test. The sandy soil allows for a ready drainage, so that there is no chance for a trial of the effect of a flooding on the conduit. It is supposed, however, that the water will cause little or no impediment to the success of the scheme.

After the trial, which was well attended, the car was derailed, showing the successful operation of the "shoe" in case of accident.

The invention is in the hands of an active management, and if everything goes smoothly there is no reason why the Green Conduit System should not be a successful competitor of the trolley lines.

Electricity Arising From Gas and Water Pipes.

A writer in *Électricité* has made the interesting observation that there is a difference of potential between the water and gas pipes in all houses and that if one terminal of a telephone is joined to the water pipe a crackling sound is heard in the telephone on lightly touching the gas pipe, which, of course, indicates the passage of a current. By substituting a galvanometer for the telephone it is found that the negative pole is formed by the gas pipe, the galvanometer deflection being permanent and constant in amount during several months, though there is a slight diurnal variation. These experiments have led to the suggestion that the pipes must be fairly well insulated from one another and might really act as conductors for telephonic communication. As a matter of fact, it is stated that conversation was successfully carried on without any other conductor between two houses at a distance of 100 metres apart, the microphone used in the experiment being joined to three bichromate cells. The small though distinct currents that are set up when the gas and water pipes are connected are attributed to a slow chemical change in the pipes, which may thus represent the plates of a battery. This hypothesis leads one to think of the probable nature of these changes and to wonder whether any effect is produced in the water contained in the water pipes, or whether perchance minute traces of metal, as a result of the change, would find their way in solution into the water. If the latter event took place another and hitherto unsuspected source of lead poisoning might possibly be traced. —*London Lancet.*

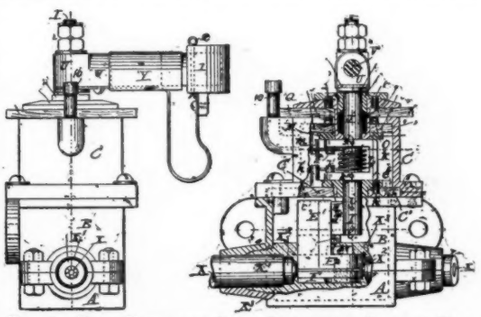


FIG. 5.—PLAN VIEW AND CROSS SECTION OF CONTACT BOX.

The sale of the Tacoma, Wash., Light and Water Company's entire plant and rights to the city of Tacoma was effected last week. The consideration was $2,000,000. C. B. Wright, of Philadelphia, takes $1,750,000 of the bonds.

LITERARY.

"Catalogue of the University of Wisconsin" for 1892-93 has been received.

Scribner's Magazine for July contains a striking article in the Men's Occupations series, by W. Clark Russell (the writer of sea tales) on "The Life of the Merchant Sailor," giving a graphic account of forecastle life in a modern sailing vessel, showing how little it has changed since the old days when Dana wrote his "Two Years Before the Mast." The abundant illustrations are by Frank Brangwyn, an English marine artist, whose work is new to American magazines.

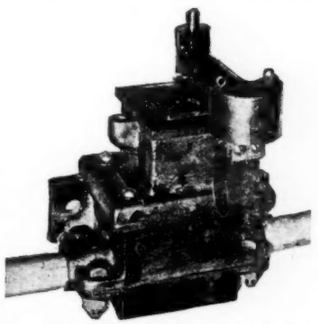


FIG. 3.—FRONT VIEW OF CONTACT BOX.

"Uncle Tom's Cabin" has certainly "broke loose!" The copyright on this most famous of American novels, by Mrs. Stowe, has recently expired, which frees its publication from the monopoly of the high-priced publishers, and though in anticipation of this fact they have within a few months greatly reduced its price, now that it is really "unchained," the consequenees are something surprising. John B. Alden, publisher, of New York, issues several editions, selling them only direct (not through agents or booksellers); one in good type, paper covers, for five cents, sent postpaid, or the same bound in cloth for 10 cents, with postage seven cents extra; also an excellent large type edition, on fine paper, handsomely bound in cloth for the price of 25 cents, postage 10 cents. Surely a copy of "Uncle Tom's Cabin" will soon be found in every home where it is not already. Mr. Alden sends a 32-page pamphlet describing many of his publications, free, or a catalogue of 128 pages of choice books, a veritable "literary gold mine" for book lovers, for two cents. Address, John B. Alden, publisher, 57 Rose street, New York.

FIG. 6.—FRONT VIEW OF CONTACT SHOE.

A plant for the manufacture of novelties, including motors for sewing machines and other light machinery, will probably be established in Jeffersonville, Ind., in a few days. Several Louisville capitalists are said to be interested in the enterprise. J. M. Parker is said to be the moving spirit in it. The capital stock of $10,000 is said to be already taken. On account of the difference in the price of land the factory will be established in Jeffersonville.

The Action of Compound Dynamos When Run in Parallel.

BY WILLIAM L. PUFFER, S. B., IN "TECHNOLOGY QUARTERLY."

While arranging some details of the wiring plan for connecting up two compounded railroad generators so that they could be tested for commercial efficiency while under the conditions of full load, by one of the purely electrical methods, my attention was drawn to the fact that the usual method of adjusting such dynamos so that they would give a constant potential at their terminals irrespective of the current flowing could not be a correct one unless the machines were exactly alike in all respects.

The general practice is to over-compound such generators, and then to experimentally shunt the series coils with a German silver ribbon until the desired "0 per cent rise" is obtained; this is well enough for a single dynamo, but when two or more are in parallel, with their series coils also in parallel, the German silver shunts do not in any way aid the different dynamos in equalizing their load, and any original structural difference

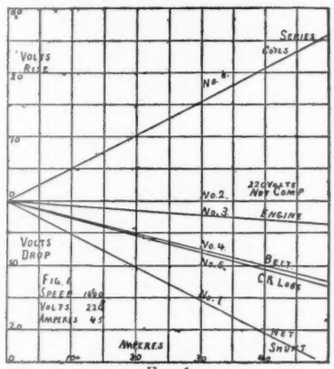


FIG. 1.

will cause the load to divide unequally. I found that in all of the power plants that I could then visit (winter of 1890–91) there was very decided evidence of this tendency to unequal division of the load, and it could readily be seen that some machines were always taking more than their share of an increase of load and tending to do little when the load fell off. There seemed to be a very common knowledge of the trouble in making the dynamos work well together, but there seemed to be no attempt to help the matter, or, as far as I could find, any knowledge of where the fault was.

A year ago the Thomson-Houston Electric Company was so kind as to loan the institute a pair of similar over-compounded motor-type dynamos which had been adjusted for "0 per cent rise." These dynamos were similar to the power generators of that company, and enabled me to make a study of the action of compound generators connected in parallel. The dynamos were belt driven from the main shaft in the dynamo room of the physical department and were under good average running conditions. A short piece of shafting was arranged so that by slipping the pulleys slightly the two armature shafts could be mechanically connected and, therefore, must at all times be at the same speed. Suitable water resistances

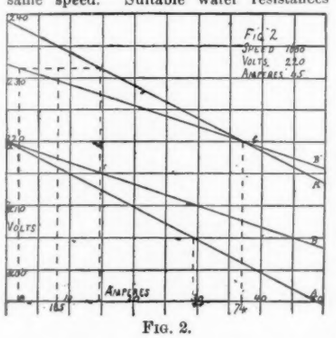


FIG. 2.

connected to each machine were used for varying the output of the armatures. Double-pole jackknife switches of the type generally used were provided for connecting the two dynamos in parallel. A dead beat ammeter was placed in each armature circuit, and an Ayrton & Perry spring ammeter in the equalizing wire; a Western voltmeter was used in connection with pressure wires to measure the voltage of either armature.

The object of this paper is not to describe these tests, but rather to explain a method of investigating the action of compound dynamos in parallel, and to point out the cause of some of the difficulties commonly met with, as well as to show that it is comparatively a simple matter to avoid them; so that the results of these tests, although very interesting, will not be given except as explanatory examples.

Considering first the action of a single shunt dynamo driven by a belt from an engine doing no other work, if now the load be gradually increased to the maximum amount that can be safely carried, and if from time to time simultaneous values of the current and voltage be taken and plotted as in Fig. 1, curve 1—for want of a better name let us call this the *net* characteristic curve of the combination—this curve would be a horizontal line (curve 2) if it were not for the sum of a number of actions, all of which tend to lower the electromotive force. Beginning at the engine there is the usual fall of speed as the load increases, due simply to the action of the governor (curve 3), the dynamo pulley lags behind more and more on account of the increasing slip of the belt as the transmitted power becomes greater; these two changes are plotted in curve 4; in the dynamo armature there are the usual demagnetizing reactions which lower the electromotive force; and finally there is the fall of potential in the armature wires as well as all the necessary leads, fuses, ammeters and connections up to the distribution point or bus bar, where the voltmeter was connected (curve 5). These separate losses may be plotted separately, and their sum will equal the amount that the net characteristic will fall below a horizontal line.

Inasmuch as the net characteristic in this combination is a very drooping one, it would be necessary to use hand or automatic means of adjusting the voltage as the current changes so as to keep the mains at the normal value. The effect of this regulation can be considered to be a raising or lowering of the net characteristic bodily without any material change in the inclination. Such regulation is always too late by at least the time necessary to produce a change of the indicating device; yet, if this amount is small, and the demand for current is not very variable, such a combination is perfectly satisfactory, and even desirable, on account of the sudden fall of voltage on a short circuit, which lessens very materially the shock to all parts of the system.

A second similar combination can be connected in parallel to this first one and the load divided between them. All that is necessary is to have the voltage of the incoming system very nearly equal to that of the bus bar or common point, and then to close the switches. Evidently if the voltage of the new dynamo were just right, no current could pass in either way, but if it were somewhat too high, then a part of the total current would change from the old dynamo to the new one. If, for example, the new dynamo were x volts higher than the old, then the current through it would be of such value as would cause a fall of one-half x on the net characteristic, and the current from the old dynamo would be smaller by the same amount. When the net characteristic is quite drooping, as is always the case with shunt dynamos, there is little or no danger of even overloading an armature when connecting it to the mains; in fact, it is common practice in central stations to judge of the voltage of the new dynamo by the looks of its pilot lamp. If the two units (dynamo with its engine) have similar net characteristics, any change of load, sudden or not, will divide equally between them; but if, as usual, the characteristics are not similar, this will not be the case, and we shall find that the unit with the steepest characteristic will not take its share of the work if the load increases, and will take more than its share with a decrease of load.

Let the lines A and B in Fig. 2 represent the net characteristics of the two units; when the armatures are in parallel and delivering no current, let the voltage be brought to 220 volts, then the two lines are common, as at a. A sudden current of 74 amperes will cause the voltage to drop to 205, and B will deliver 45 and A 29 amperes. If now the load is equalized with 37 amperes in each armature, and the voltage brought up to 220 by the use of the regulating rheostats, the lines A and B are raised to A^1 and B^1, respectively, being common at b; now let the total current be dimished from 74 amperes to 16.5 amperes, a similar construction shows that the voltage will rise to 231.6 volts, and that A will deliver 14.5 amperes, and B 2 amperes.

When two dynamos with net characteristics like these are subject to a rapidly changing load, it is impossible to evenly divide the current, and a balance has to be struck between the limits on the one hand of the dynamo A driving B as a motor—which will, of course, do no especial harm other than to waste energy in heating and sparking—and on the other hand of melting the fuses of dynamo B during an unusually heavy call for power, which might have been safely carried by the fuses if equally divided. It is plain that in this case the combination of the two dynamos is not double the capacity of either one, and the commercial efficiency is considerably lessened by the want of similarity of the net characteristics.

It is very desirable on many accounts to have a dynamo which will automatically maintain an approximately constant potential at the switchboard, irrespective of the amount of current flowing. We may add a series winding to the dynamo of just sufficient number of turns to give such a magnetizing effect as will produce a voltage which shall be at all times exactly equal and opposite to the combined effects of the change in engine speed, belt slip, armature reactions, and the drop of voltage due to the resistance of the armatures, lead wires, ammeter, safety devices, and the like, up to the bus bar (Fig. 1, curve 6). The net characteristics will now be made up of the sum of the individual effects, as shown in

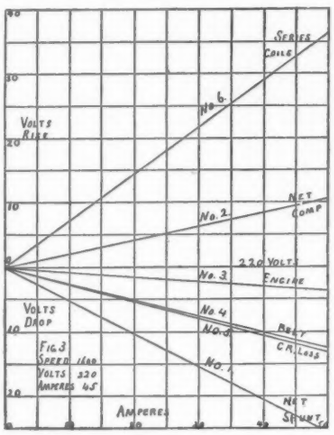


FIG. 3.

Fig. 1, curve 2, and the voltage at the switchboard would be constant at all times were it not for the hysteresis of the iron in the magnets, which will very slightly prevent the instantaneous rising and falling of the effect of the series coils, and any change in resistance due to temperature change. The temperature change will be slow, and is corrected by an occasional change of the rheostat in the shunt coil circuit and can be neglected for the present.

Should it be necessary to use a second dynamo of exactly similar design, we cannot proceed as in the case of simple shunt dynamos, for this reason: If the new dynamo is at exactly the same voltage as the mains at the switchboard when connected in parallel, the combination will be unstable because if for any cause the voltage of either dynamo varies a little, so that the new machine becomes ever so slightly a motor, the effect of the reverse current in its series coil will be to weaken still more the electromotive force, which will allow an increasing current to flow until something burns out.

If, however, there is a third connection made so that the brushes, as well as the terminals of the two dynamos, are connected, it becomes impossible for this reversal to happen, and the machines will run perfectly under all changes of load. There are in use two ways of arranging the switches (Fig. 4 and Fig. 5), either of which is satisfactory; but the one shown in Fig. 5 is better, as the idle machine is completely disconnected from the circuits.

An examination of the components of the net characteristics (Fig. 1, curve 2) shows us that, if the incoming dynamo be brought up to the voltage of the switchboard and the switch closed, the load will instantly divide between the two dynamos, with no disturb-

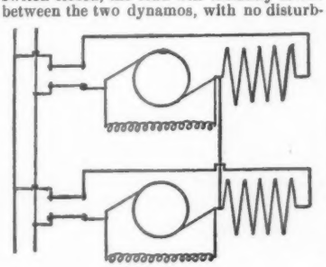


FIG. 4.

ance or shock of any kind. Suppose, for instance, that the loaded machine is giving out 40 amperes, we see from the net shunt characteristic (Fig. 1, curve 1) that there is a drop of 20.5 volts, which is made up by the effect of the series coil (curve 6), giving a terminal potential of 220 volts. When the new machine at 220 volts is switched in parallel, we may first consider that one-half the total current of 40 amperes passes through each of the parallel series coils, and from curve 6 we see that the volts-rise is cut down from 20.5 to 10.2 in the first dynamo and raised from zero to 10.2 in the new one; from curve 1 we see that for each dynamo this change of 10.2 volts just compensates for a current of 20 amperes through the armature circuits, and that the total load of 40 amperes at 220 volts will be equally divided between the dynamos.

The action of compound constant potential dynamos in parallel is generally misunderstood, and the equalizing connection is credited with a remarkable power of control over the output of such dynamos which it does not and cannot have, as can be seen by watching the dynamos while at work, as well as by examination of the make-up of the net characteristic (Fig. 1). The common idea is that the equalizer has the property of compelling a lagging dynamo to take its share of the work, and we hear of the wonderful power of control which it has even over dynamos of different types and sizes running under somewhat different conditions. Now, the real effect of the equalizer is to put the series coil in parallel, so that the total flow of current from the plant will divide between them inversely as their resistance without any regard as to whether this current comes from one armature alone or is divided among many; and hence it follows that it cannot in any way exercise even the slightest regulating effect on any one dynamo that it does not have over all the rest. The armatures themselves are running in parallel under the usual conditions of ordinary shunt dynamos, and the total current will divide between them under the same laws that would hold if there were no series coils at all and the current were taken from the two main wires, to which the brushes are connected, as has already been pointed out in a previous part of this article.

The net characteristic of the plant is then a falling one, as far as the armatures are concerned, to which has been added the automatic regulation of the parallel series coils, which act together in proportion to the total flow of current from the station; and if these series coils are all alike in effect, each dynamo will have its voltage altered by an equal amount in proportion to the output of the station, but each armature will not do its share of the work unless all the net falling characteristics are exactly similar.

In a plant of such dynamos, each driven by its own engine, it is most likely that the net falling characteristics of the armatures will not all have the same steepness, and, consequently, a fluctuating load will not

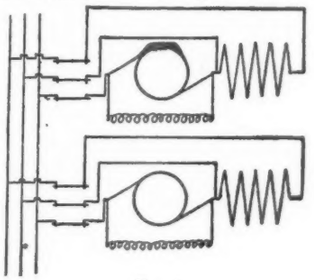


FIG. 5.

be shared equally by the dynamos; but it is possible to so arrange things that the series coils do not all act equally on the armatures, and if the resistances of the series coils are slightly changed by the addition of a little German silver or copper ribbon, so that the total flow of current divides between the different series coils in such a proportion that the individual net armature characteristics are raised by just the right amount, we again have a plant in which a fluctuating load will divide equally among the different dynamos. The same effect may be produced by the addition of a small resistance in the armature circuit of any dynamo which takes more than its share of an increase of load. A number of machines so adjusted will run together perfectly, and there will be no change of voltage or any difficulty experienced in cutting in or out by the use of the ordinary two or three-pole switch; the only precaution to be observed is to have the voltage of a new machine nearly that of the bus bars, for then, when the series coil is put in parallel with all other series coils, it will be traversed by such a part of the total flow of current as will be sufficient to raise the voltage of the armature enough to enable it to deliver its share of the total output.

If a dynamo is to be cut out it will not do to reduce its load first by the use of the resistance in the field circuit, because by this process its load is transferred to the other dynamo armatures, and the station voltage will consequently fall somewhat, because the series coils are not proportionately increased. This fall of voltage may or may not be permissible, and is avoided if the switch is opened while the dynamo has its share of the load.

Sometimes it is desirable to have a dynamo which will maintain a constant potential at a point some distance from the switchboard; in this case the series coils will have a few more turns, so as to make up for the

fall of potential in the mains; and in Fig. 3 will be found the component curves for a dynamo adjusted for approximately "5 per cent. rise." Curve 1 may be called the "net shunt" falling characteristic made up of the sum of the effects due to the engine change, belt slip, and the fall of potential in the armature circuits represented respectively by the curves 3, 4 and 5. Curve 6 shows the rise of voltage due to the current in the series coils, and is greater than the total drop curve 1 by an amount plotted as curve 2, which is the net characteristic of the over-compounded dynamo.

Should the demand for current exceed the capacity of one dynamo, the addition of a duplicate machine will render it impossible to maintain a constant potential at the distant center unless both dynamos are run all the time; for while 45 amperes on one

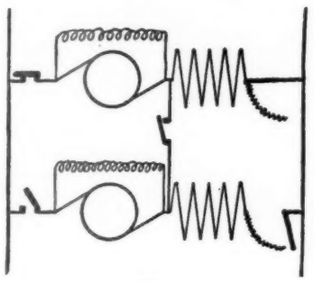


FIG. 6.

dynamo will cause a net rise at the switchboard of 9.5 volts, the same total current furnished by the pair will only produce a rise of 4.75 volts.

If this want of exact regulation does not require the constant running of two dynamos at times of light load, we meet greater troubles in the process of adding the second unit when the load is too heavy for the first one. From the data given in Fig. 3 it is possible to see what will happen under any given conditions when the machines are put in parallel. I have experimentally verified this method of predicting the actions of compound dynamos, and find it exact enough for all practical purposes.

Suppose one dynamo is loaded, what will be the effect if we connect a new one when its voltage is lower, the same as, or higher than the switchboard? I will take from my notebook the results of some experiments on two dynamos with characteristic curves like Fig. 3, first giving the observed results and then calculating them from the curves.

The armatures were mechanically coupled and, therefore, at same speed. Voltage of each was 222; 30 amperes were taken from No. 2 dynamo and voltage rose to 228, while that of No. 1 fell to 212; then by a double-pole switch No. 1 was put in parallel. Momentarily No. 2 tended to overload and drive No. 1 as a motor, but in a few seconds the load became steady at a voltage of 222, No. 1 furnishing 18 and No. 2, 12 amperes. Now by calculation from curves of Fig. 3:

No. 1.	No. 2.	
222.	222.	Volts at switchboard with no load.
— 7.5	— 7.5	Curve 4. Drop due to speed change when a current of 30 amperes was taken from No. 2.
214.5	214.5	
	— 8.	Curve 5. Armature drop with 30 amperes.
	206.5	
	+ 21.5	Curve 6. Rise from 30 amperes in series coils.
	228.0	Switchboard voltage with 30 amperes output.

Put in parallel with same load, so no change is to be made for speed change.

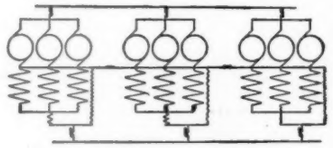


FIG. 7.

From Curve 6 we see that the change of half of the current from the series coil of No. 2 to No. 1 will raise No. 1.

No. 1.	No. 2.	
214.5	228.0	No. 1 with no load and 30 amperes on No. 2 and then put in parallel.
+ 12.0	— 12.0	Curve 6. Change in voltage with change of half current from series coils of No. 2 to series coils of No. 1.
226.5	216.0	
— 4.	+ 4.	Curve 5. Suppose each armature carried one-half the current, then there would be a drop in No. 1 and a rise in No. 2.
222.5	220.0	

We must now add a current to the highest voltage dynamo, or No. 1, that will cause a drop of one-half of 222.5 — 220 volts, which from curve 5 will be 4.7 amperes.

Then the voltage of the combination will be 221.2; and dynamo 1 will deliver 15 + 4.7 = 19.7 amperes, and dynamo 2, 15 — 4.7 = 10.3 amperes.

Calculated 19.7 amperes, dynamo 1. 10.3 amperes, dynamo 2. Voltage of 221.2.
Measured 18 amperes, dynamo 1. 12 amperes, dynamo 2. Voltage of 222.

Take, for another example, the case when one of these dynamos was at full load and the new machine was brought up to exact voltage and then put in parallel, and applying these methods we shall see that it may happen that all current may be cut off by the melting of a fuse.

Dynamo No. 1 at 220 volts and no load, then as the load of 45 amperes comes on, the switchboard voltage will be about 230 volts.

230.	
— 11.2	Drop due to load. Curve 4.
208.8	
— 11.7	Drop in armature. Curve 5.
197.1	
+ 32.5	Rise from series coil. Curve 6.
229.6	Volts at switchboard.

Here the switch is closed.

No. 1.		No. 2.	
229.6		229.6	
— 16.2	22½ amperes in series coil. Curve 6.	+ 16.2	
213.4		245.8	Armature voltage.
+ 11.7	Curve 5, to find internal voltage.		
225.1	Armature voltage.		
	245.8	Armature voltage No. 2.	
	225.1	Armature voltage No. 1.	
	20.7	Difference of armature voltages.	
	11.7	Drop in No. 2 with 45 amperes.	
2) 9.0		Acting to send reverse current through No. 1.	
4.5		Curve 5 corresponds to current of about 17 amperes.	
	245.8	Armature voltage No. 2.	
	— 17.0	Drop with 62 amperes. Curve 5.	
	228.8	Switchboard voltage.	

Dynamo No. 1, which was loaded, has a reverse current of 17 amperes and is driven as a motor, while the new dynamo carries the load and is 17 amperes beyond its rated capacity. We see that the switchboard voltage practically does not change under these conditions, but to offset this there is the sudden change of a loaded dynamo into a partially loaded motor and an overload on the incoming dynamo. Such changes would be accompanied by much sparking at the brushes and the liability of thrown belts or blown fuses. Then we may say that if the new dynamo is of lower voltage when connected the voltage will change considerably, but there will be no shock to the dynamos; if the new dynamo is at the same voltage, then the voltage will remain about constant and the armatures will receive a shock; if the new machine is still higher, then the shock will be very severe and the voltage will rise. I had no time for taking readings on the last experiment, but I did notice that the needle of a 150 ampere instrument was out of sight before a switch could be opened.

There is a very safe and simple method of throwing in a new dynamo, which does not, however, prevent a change in the switchboard voltage unless a special switch is used, as shown in Fig. 6, constructed in such a way that the equalizing connection is first made, and then the outside end of the series coil gradually connected by a switch with a few resistance points in it, while at the same time the magnetizing effect of the shunt coil of the loaded dynamo is increased to make up for the loss in the series coil. In this way the series coils can be put in parallel with no jump in the voltage. If, however, there are many similar dynamos in the plant, it might be that the change produced by throwing in a series coil without its armature would not produce a greater change than would be allowable; in such a case the safest way is to connect first the series coils, then rapidly adjust the armature voltage by the voltmeter, or, if in a great hurry, by the hooks of the pilot lamps, and then close the armature switch, well knowing that the steep net falling characteristic of the armature circuit will prevent an overload.

The common three pole switch generally used can easily be changed so as to admit of working in this way by cutting through the top of the insulating bushing and putting a separate handle on the blade which closes the armature lead to the bus wire; then pulling the ordinary handle out will open all blades at once, but pushing it in will only connect the series coils, leaving the armature circuit open. If the wiring is so that the series coils are permanently connected and a new dynamo is thrown in by a single pole switch, we have here a very wide range of voltages for the new dynamo, and pilot lamps may be used to judge the voltage. We have two bus bars with all the series coils joined between them; evidently, then, the total current flowing from bar to bar will simply divide between these coils inversely as their respective resistances, and we shall, in consequence, have the voltage of the armature bus bars rising and falling with the total current from the plant; and if the machines are similar all of the armature voltages will rise and fall together. If this is so, and it cannot be otherwise, these armatures are to be considered simply as net falling characteristic armatures working in parallel between the equalizing bar and the hird bus bar, and the division of the load between them will take place exactly as has been previously shown for common shunt dynamos, and therefore, inasmuch as we have a decided net falling characteristic, there is but little danger of an overload on a new dynamo armature.

It is now clear that when we wish such dynamos to run together we must first adjust the resistances of all the series coils and connections, so that when a current is passing through them, but not through the armatures, the armature voltages must be equally affected; and also see that the armature circuits are so arranged as to give the same net falling characteristics independent of the series coils. It is necessary for good compounding to have the brushes set once for all, and in all well-designed dynamos it is possible to find a point where there will be no excessive sparking. An easier although not so good a way to adjust is to find the best point for the lead and then alter the resistances of the series coils until all dynamos have the same net characteristics; but the rise of the voltage, due simply to the flow through all the series coils, will in this case be different in different dynamos, and there will be a little more difficulty in adding a new dynamo, and a tendency to overload.

Nearly all of the compound dynamos in the market for the last few years are purposely built with too many turns in the series coil, and then a shunt of German silver is adjusted by trial at the factory until the voltage at the terminals shows the wished for "0 per cent. rise," or whatever it may be. Now for any one dynamo running under the conditions of the experimental trial this method is simple and perfectly correct; but when such dynamos are run to-

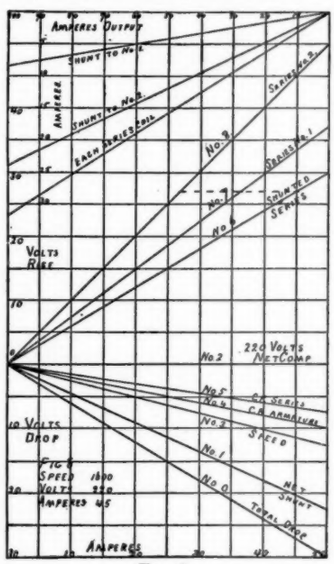


FIG. 8.

gether in multiple it is of no service, and has no effect on the relative actions of the series coils of the dynamos, because of the fact that all coils and all shunts become parallel conductors, and therefore traversed by currents inversely proportional to their resistances. These shunts then merely diminish the total flow of current through the series coils, but in no way do they serve to adjust the effect of the series coils relatively to each other. If it should happen that one dynamo was very much over-compounded and then shunted for the "0 per cent. rise," and another only very slightly over-compounded and consequently only slightly shunted, it is plain that when the shunted series coils are in parallel the shunts will have only the effect of affording a path for a part of the total flow of current, and consequently could be wired up in any convenient place on the switchboard. These two above-mentioned dynamos would then be dissimilar over-compounded machines working in parallel, and in all probability an increasing load would be largely carried by the dynamo with most turns in the series coil, because an increase in total current flowing through the series coils would promote the voltage of this dynamo faster than that of the other. This will be the familiar condition we often see in power plants where the average load is equally divided, while an overload is taken quicker by the dynamo which takes the less at light loads, that is, the one in which the series coils have greatest effect.

In order to make such dynamos work properly, it is best to examine the lead and the wiring, and if possible, give the armatures similar net falling characteristics, and then, by the use of copper or German silver ribbon, slightly change the resistance of the series coils until all armatures are equally affected by the flow of current in the series coils; a single large shunt may be connected at any part of the bars to which the series coils are attached, or perhaps better each machine may have a shunt across the series connections at the switchboard, on the dynamo side of the main three-pole switch, so that the total shunting capacity varies as it ought with the number of dynamos running.

After one of my lectures a few weeks ago two young men asked me for an explanation of what seemed to them a very strange phenomenon, which always occurred when a large dynamo was cut out of service; and, as it is a very good practical example of the use of multiple characteristics as I have shown them, I will give it. In a railroad power house are about sixteen 100 horse-power "0 per cent. rise" dynamos and one large 500 horse-power "0 per cent. rise" dynamo, all provided with shunts. Ordinarily the machines all do well enough, but as the load gets light at night and the big one is cut out the voltage rises instantly about 30 volts in some unexplained manner. May not this be the reason: The series coil and shunt of the large dynamo are of so low resistance that they carry a large part of the total current in all the series coils and shunts? Now when the machine is to be cut out, the current in the armature is cut down by the rheostat in the shunt field circuit to as nearly as may be nothing; but this current is in this way slowly shifted to the other 16 armatures, causing a slight fall in voltage, due to the net falling armature characteristics, which drop is not counteracted by the series coils because there has been no change in the distribution of the total current. This slight fall is probably not especially noticeable, but the sudden jump comes when the series coils and shunt ribbon of the 500 horse-power dynamo are cut out of circuit and the larger current in them is instantly transferred to the series coils of the other smaller dynamos. If the switches were made to stand the arcing, I doubt if there would be much change noticed if the dynamos were simply disconnected without gradually diminishing the armature current.

It has been supposed in this paper that there is no such a thing as time required to change the strength of dynamo magnets, and that there is no difference between the ascending and descending magnetizing curve of iron. These time effects will not come in for ordinary fluctuations if the net armature characteristics are similar, and consequently the required changes in all the magnets would be of the same amounts and would, therefore, take nearly the same time; for sudden changes like a short circuit it is not likely that the load would divide equally, but it would be very much nearer so than with the ordinary unadjusted dynamos, and a heavier short circuit could be burned out than with unadjusted dynamos, where some would rapidly overload and open their circuit breakers and thereby precipitate a general breakdown.

In large plants, where more than one dynamo is driven by a single engine, and there are several engines, it will be found of advantage to adjust each set of dynamos so that they will work well together, and then adjust each engine load for engine speed change. To do this, each dynamo on a single engine would have its series coil and shunt properly adjusted until, as far as that particular engine load is concerned, the load would be equally divided between the armatures; then the sets of series coils corresponding to the different engines would be connected through a small resistance to the station bus bar, and we should find that the total load could be evenly divided between the engines. The arrangement of these resistances is indicated in Fig. 7, which shows three engines, each driving three dynamos by belts or any convenient way. The three series coils of each unit are adjusted so that a changing load will be equally shared by each dynamo, and then the tree coils are shunted until the desired compounding is attained. It is now necessary to compensate for any difference there may be in the speed regulation of the engines or in the main belt slips by a slight change in the total resistance of the three sets of parallel series coils. There will be, of course, the usual precautions necessary when throwing in or cutting out a set of dynamos, and the most satisfactory way, if steady voltage is to be desired, will be to close the three large main switches at once, by steam or other power acting upon heavy switches built to stand the arcing of such currents, thus connecting simultaneously the three bus bars to the station main bars; the same method should be used to disconnect when the time comes for stopping an engine.

In order to study the action of dynamos, which were exactly similar in all respects, except the magnetizing effects of their series coils, a number of turns of wire was wound upon the magnet spools of dynamo No. 2 and connected in series with the regular windings, and the resistance of the series coils of dynamo No. 1 was made equal to that of No. 2 by the addition of a length of copper wire. Each dynamo was then fitted with the usual German silver shunt of such

(Continued on page 256.)

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Our readers will doubtless find much to interest them in the article on "The Action of Compound Dynamos When Run in Parallel," by Prof. William L. Puffer, of the Massachusetts Institute of Technology, which is published in full in another portion of this issue.

Is it worth 10 cents a day to keep cool during the heated term? That's about what it costs to run an electric fan. Tell this to your perspiring friends, show them how nicely your electric fan works, make 'em envious and thereby increase the sales of this summer boon.

Could there be a better location for an electric road than upon an elevated structure? We expect rapid transit in the near future, and we want the best. The damage done to property on the line and suits resulting from "cinders in the eye," would more than warrant a change from the puffing locomotive to the cleanly, noiseless motor cars.

Strenuous means should be taken to prevent a recurrence of an incident such as happened last week in the City of Churches. It was quite an exciting race. There were two trolley cars, one switch and a smash-up. The sight of two weak-minded motorneers racing to find out whose car could reach the switch first is enough to confirm one in the idea "that all fools are not dead yet." An example made of these men would be beneficial as a warning for the future.

An English technical journal prints the following in a news column:

REPLY TO "NERVOUS SUFFERER."—Don't be morbid. It is true physic cannot cure you, but if you try electricity in the form of mild continuous currents, as generated by wearing the new combined Electropathic Belt and Suspender, you can be speedily restored to health. This perfect scientific appliance is very comfortable to wear, and imperceptibly conveys the currents direct to the affected parts. Call and avail yourself of a free personal consultation, or write at once for pamphlet.—Note only address, the Medical Battery Company's Institute, 52 Oxford street, London, W.

Comment is unnecessary.

We suggest that an enterprising young man might benefit himself pecuniarily by toting around an Edison phonograph with an appropriate collection of records from one summer resort to another. A parlor entertainment might be arranged for which a small admission fee would be required. The young man would be sure of a vacation, at any rate.

Ever since Horace Greeley gave his celebrated advice, "Go West, young man," some of those who took it improved with the towns as they grew to thriving cities, but it was a slow growth, and it is their heirs who have profited most. Many of the now oldest inhabitants can tell of the tortoise-like rate of improvement until the advent of electricity; then, with a start the conservatives awoke to the fact that the old town must make things lively to keep pace with the surrounding cities. The younger members of the community said, "Pushville has an electric light plant, why shouldn't we?" Then the conservative tried to put down his foot. No use now; electricity and the future of the town is at stake, and his negative is overruled. Electricity is adopted and the town begins to grow. This is the beginning. Then follows closely the electric railway and the telephone. Immigration takes place, for the incentive is there; and thus is the town, soon to be changed to a city, given a push upwards which lands it sooner or later among the many thriving cities of this country.

GRAY MATTER SAVED BY THE TROLLEY CARS.

Steps in progress are nothing more than the changing of circumstances and methods to suit our ever-increasing needs. That which is inconvenient and not an improvement in some way upon what existed before is obviously not a step in progress and therefore has no reason for existing. Advantages do not always balance disadvantages, and often a slight convenience in one direction will overcome many other apparently more serious difficulties.

Many people have thought of the ever-present trouble of being obliged to catch a certain train at a certain time, and in a measure they have grown accustomed to the evil, as "eels get used to skinning." But a solution is presented in the form of the suburban trolley lines which run cars at very short intervals. Now there need be no extravagant waste of gray matter in order to catch trains—simply take the next one, and to misquote a tender and touching advertisement we would say:

"Suburbanites don't worry, your troubles now are past.
For the pain of having to catch a train is gone from you at last."

THE TROLLEY CAR A SUBJECT FOR A SERMON.

Recently the Rev. William Thomas Beales, in the City of Churches, delivered a sermon on "Lessons from the Trolley Car." He chose his text from the fourth verse, second chapter of Nahum, which refers to the chariots racing along the streets like streaks of lighting. The reverend gentleman presumed that if that hidden meaning existed it was a reference to the trolley car in preference to the railroads. He spoke of the glowing future of the electric road and accused the railway companies of being selfish corporations; and in explanation he said, "They run through any and all streets where they can get a franchise whether the residents of the streets object or not. I think the city should take charge and manage the street railways just the same as they do other municipal affairs."

It is to be regretted, of course, that there are objectors; but every scheme must have some people who are against it; and, of course, there are streets in which to run a line of cars might be considered an act of desecration. But in the majority of cases handsome and comfortable electric cars are an improvement to which any patriotic citizen may point with pardonable pride.

LETTERS FROM A LABORATORY.—LII.

BY JULIAN A. MOSES.

There was brought recently to the laboratory of a friend some peculiar pieces of zinc which having been worked in a lathe had acted queerly. The metal appeared crumbling, crystalline, and in fact, it looked as if it were full of impurities and that it might disintegrate under the slightest strain. Upon questioning the workman who had observed these facts, I found that the metal had crumbled under the tool in the lathe and was almost impossible to work. As soon as the tool touched the metal pieces would drop off as if there was no cohesion between the particles themselves. It appeared as if the molten zinc had been suddenly cooled after it had been cast and crystallization had taken place. This was found, however, not to be the case, for I was assured that a long time had elapsed before the temperature of the metal had become low enough to allow of its being conveniently handled. It was evident then that there was some other cause, and it was possibly due to the presence of some impurities in the zinc.

Analysis showed that the zinc was reasonably pure, the impurities consisting mainly of antimony and iron, but not in sufficient quantities to materially affect the zinc.

It is a well-known fact that zinc is an uncertain metal in the workshop. It is difficult to tell when a casting is produced which can, with safety, be depended upon. Devices for foundry work have been made which were supposed to remedy this granulation in casting, but they were discarded as useless before even leaving the testing laboratory. Uniformity of excellence in the production of zinc castings can only be obtained by employing due care in the regulation of the means used, whatever they may be.

The addition of about a quarter of a pound of sal ammoniac to the pot of zinc while the metal is in a molten condition will tend to produce a hardening and toughening which will render the working of the casting more satisfactory.

Even with this "cleared" zinc, as it is called, it is difficult to get a polished surface. Like aluminium, if a polish is obtained it is not easy to keep the metal from tarnishing without some protective covering, either by a varnish or lacquer, or by the electro-deposition of some non-oxidizable metal.

The best kind of a varnish for zinc, if a black surface is desired, may be procured by using asphaltum, generally known as Brunswick Black. This gives a surface which is proof against many of the chemicals in ordinary use in the laboratory.

If a metallic blackened surface is wanted a weak solution of copper sulphate may be poured over the object, which will thus have deposited upon its surface a dense black coating of copper oxide. This, however, may be easily rubbed off and requires lacquering, but makes, when thus prepared, a very serviceable coloration for large pieces of work, such as bases for small dynamos which require zinc bases as magnetic insulators.

A bright metallic covering may be obtained through the electro-deposition of the metal—tin—in a solution of substances prepared in the following proportions:

Proto chloride of tin	1 part.
Sodium pyrophosphate	7 parts.
Distilled water	250 "

This should be put into any convenient plating jar, and, using a few pieces of pure tin for the anodes and making the zinc casting the cathode, a coating of tin may be put upon the zinc, which will thus be prepared to resist the action of the dilute acids of the laboratory. A rather weak current should be used, as a strong one tends to make the deposit porous and brittle. Should it be desired to have the tin even harder and more dense, this can be done by burnishing with a stone or steel burnisher.

If the tin deposit be required simply for the lustre that it affords, it may be put upon the zinc by dipping, protecting it afterwards, of course, by some transparent varnish.

It is better not to copper-plate zinc for often a local electrolytic action is set up between the two metals, thereby wasting away the zinc and loosening the coating of copper.

CORRESPONDENCE.

OUR BOSTON LETTER.

The Steadily Increasing Business of the Campbell Electric Supply Company of this city has necessitated their establishing a branch house in Pennsylvania, and an agency for that territory has been placed with the well known supply house of Spaulding & Metcalf, at 55 North Seventh street, Philadelphia. They will carry a full line of the Campbell Company's "Century" tape, insulated wires, cables, etc.

At a Special Meeting of the stockholders of the Worcester & Millbury Electric Street Railway Company, held in Worcester, June 28, it was voted unanimously to increase the corporation capital $150,000, which will give a total capital stock of $300,000. The new increase of stock will be used to pay in full the corporation debt of $128,000, and in the further equipment of the road. Members of the road's directory express the opinion that the whole of the new stock will be taken by present shareholders.

The Stirling Water Tube Boilers are gradually gaining a firm footing in the East, and as their many good points become more generally known, they are sure to supplant many of those now in use, especially in electric railway power houses, where the maximum efficiency and minimum cost are such essential features. J. Bradford Sargent, general agent for New England, reports that he has just installed a 250 horse-power Stirling boiler in the power house of the Portland Railroad Company, at Portland, Me., and expects to increase it to 3,000 horse-power within the next year, in addition to a number of large plants for which contracts are now under way.

The W. S. Hill Electric Company, of this city, have just published their revised catalogue for 1893, and it will be found an extremely valuable little book. It is of a convenient size and handsomely gotten up throughout. It is devoted chiefly to their large line of switches, rheostats, fuse blocks and special switchboard construction, and is profusely illustrated, showing every conceivable device in these branches of the trade. Most of the specialties manufactured by the company are under their own patents, as Mr. W. S. Hill, president and electrician, is one of the pioneers in the business, and an eminent authority on electrical matters. Since the reorganization of the company their plant has been enlarged, new machinery installed, and they are now prepared to handle large contracts for special work of any kind. H. G. T.

Boston, July 1.

The Association of Edison Illuminating Companies.

Secretary W. J. Jenks, 44 Broad street, New York city, has issued the following circular:

To the Members of the Association:

In accordance with the by-laws, the next annual meeting of the Association will be held on Tuesday, August 8, 1893. The last convention committed to the executive committee the question of the place of the meeting, which is now definitely announced, and Chicago has been fixed upon as the most desirable center for the gathering of this year.

Arrangements have been made for accommodation of the delegates at "The Rochester," a new and desirable hotel operated on the European plan, at South Park avenue and Twenty-third street, overlooking Lake Michigan. This is about half a block from the suburban station of the Illinois Central Railroad, where trains can be obtained every few minutes for the center of the city and also for the World's Columbian Exposition. It is also about four blocks from the elevated railroad which runs into the Exposition grounds, and about three blocks from Michigan avenue, where coaches can be taken to the Exposition gates. These conveniences of transit will probably be important, not only because the delegates will undoubtedly spend a large part of their time while in Chicago in attendance upon the Exposition, but also because it is now proposed that the sessions of the convention shall be held on the grounds.

The terms at "The Rochester" will be as follows: Single rooms (a limited number), $2 per day; first-class room, $3 per day. Suites with private hall at reasonable rates. A deposit of $5 will be necessary to secure an engagement of one or more rooms.

The hotel was originally intended as an apartment house, is quite large, and very much like a first-class New York flat house.

Applications for rooms should be made as soon as possible, indicating as nearly as may be what is desired and for how long a time. They should be made through the secretary.

Later announcements will be made of special features, including the programme of the convention.

PERSONAL.

Mr. M. M. Hayden, of the Law Battery Company, has returned to New York after an absence of several weeks in the West.

Mr. S. G. Booker, general manager of the Fidelity Carbon Manufacturing Company, St. Louis, was in New York last week.

Mr. H. L. Shippy, of the John A. Roebling's Sons' Company, returned to New York last week after an extended visit to Europe.

It is reported that Henry Villard intends to resign from all the companies with which he has been identified, and that he will retire from active business life.

President Daniel F. Lewis, of the Brooklyn City Railroad Company, completed on June 28 twenty-five years of continuous service as an employé of the company. He started as a ticket agent.

Messrs. E. A. Leslie and H. J. Smith, well-known electrical men, recently returned from an European tour. Their experience on shipboard is reported to have been chuck full of interest and some principal also.

Col. David B. Parker, vice-president and general manager Bell Telephone Company, of Buffalo, was a New York visitor last week, and was warmly greeted by scores of friends. The Colonel is not only an experienced and widely-informed telephone official, but is one of the most popular and genial men in the business.

Frederick Win Royce, of Washington, D. C., arrived in New York one day last week and spent four hours with Jesse H. Bunnell talking over war experiences. Both of these distinguished electricians were expert telegraph operators during the war, and their experiences during those trying times were full of the elements that tried men's souls. Mr. Royce returned to Washington at 5 P. M. of the day he came—the fact that the police heard he was here, of course, having nothing to do with his sudden departure.

Miss Margaret Joanna Roebling, daughter of Mr. and Mrs. Ferd. Roebling, and granddaughter of John A. Roebling, builder of the Brooklyn Bridge, and Dr. F. A. C. Perrine, were married at Trenton, N. J., on June 28. The wedding took place under a canopy of smilax and La France roses. After the ceremony luncheon was served under varicolored tents on the beautiful lawn of the Roebling residence. Dr. and Mrs. Perrine will make their home at Palo Alto, Cal., where the groom is professor of electrical engineering in the Leland Stanford, Jr., University.

A Very Handsome Price List.

With a strikingly illustrated cover in colors the Okonite Company, Limited, of New York, has issued price list No. 6. As a specimen of neat printing it is to be highly commended. The many valuable wire tables, relating to telephone and telegraph wire, conductors for low, medium and high tension currents, underground and submarine cables, etc., would indicate that the company had reduced this branch of its business to an exact science.

There is much of statistical and technical value in this little publication condensed to a degree that will certainly fill the heart of the busy insulated wire purchaser with joy. The company very happily concludes with the following announcement:

Heretofore it has been our custom to embody in our price list numerous letters of recommendation, setting forth the fact that Okonite has given perfect satisfaction and has always been all that we claimed for it ("the highest insulating medium in the market"). When we have written for such letters we have always received the most favorable replies, and know that the best argument used by other manufacturers of insulated wires is to the effect that their wire "is as good as Okonite."

This has led us to refer all desiring the best to apply for recommendations to any of the electric light, railway, telephone or telegraph companies who have been or are using our product, as we feel that with our great care in manufacturing, such replies as they may receive will bear out our statement, and cannot but be to our credit and will result in the extensions of our output.

Wall Street and the Electrical Stock Market.

The one absorbing feature of the Wall Street market during the past week has been the exceedingly tight money market. The conditions which brought this about are an outgrowth of the business depression which has ruled during the past two months, and which culminated during this period under review through continued shipments of currency to the interior, the accumulation by corporations of large sums for the payment, during the first week in July, of dividends and interests, and the unusual demands which were made upon the banks for loans. The rate ranged as high as 30 per cent. until the middle of the week, when it suddenly jumped to ⅛ and interest, which is equivalent to about 71 per cent. This was immediately followed by a bid of ⅜ and interest, and it looked for the moment as if the market would go to pieces. At this juncture a loan committee from a number of prominent banks appeared in the market with $6,000,000, half of which was loaned at the exorbitant rate of 71 per cent., and a portion of which went at 6 per cent. This had a tendency to ease the situation.

The most strenuous influences have been exerted on money sources. As a result a number of corporations, namely New York Central and St. Paul Railroad Companies having interest to pay on July 1, commenced to pay the same June 29. The shipments to the interior were heavy up to Wednesday, and have resulted in satiating the demand. The return movement has not yet commenced, although it is expected next week. It is thought that about the seventh of July that money will work onto a permanent easy basis, owing to return shipments, possible imports of gold to cover sterling loans made during the past week, and the heavy July payments of interest and dividends.

Next to tight money the most demoralizing factor in the market was the silver situation. The action of the India counsel in closing its mints to silver had an immediate effect on white metal values in this country and London. Silver sold at 81½ cents per ounce before the action was taken. The price immediately thereafter showed a decline of 4½ cents. The price to-day is 62 to 65 cents. At this rate the silver dollar is worth about 50 cents.

This radical drop in silver created semi-demoralization in every security that is in any way dependent upon the silver industry. Railroads, a prominent part of whose freight is silver ores, notably Denver and Rio Grande and Union Pacific, showed pronounced declines. The immediate effect will be to close up the small mines in the West and to cause a curtailment of operations in the larger properties. The Kansas City Smelting and Refining Company, the largest in the business, informs a representative of the ELECTRICAL REVIEW that it will restrict its operations in silver smelting about 75 per cent. Weaker smelters will be forced to close down.

It is thought in well posted circles that the action of the India council will not ultimately cut off the market for American silver. The present condition of prices has about discounted the situation, and a repeal of the Sherman silver law will not have a tendency to aggravate it.

The silver men of the West have experienced a pronounced change of heart, accept the situation with resignation, and are now advocating a repeal of the law. President Cleveland has called an extra session of Congress for August 7, and it is believed that he is assured of the repeal of the Sherman silver law. This action should immediately stimulate values and cause the long looked for advance in the stock market.

The exceedingly high rates for money and the continued liquidation of investment securities has put an end to all legitimate buying. This left the market in the hands of the bears, an opportunity which they improved to its fullest measures. The result has been sagging prices, with spasmodic rallies, and a close to-night much lower than the opening on Monday. There is a very heavy short interest in all the active stocks, the covering of which will materially advance quotations.

One of the stocks which suffered the most through bear operations was General Electric. It led a very irregular career, fluctuating over the range of several points each day since Monday, reaching its lowest on Tuesday, when it sold at 65½. Thursday it sold down to the same figure after a rally on Wednesday.

The recent liftings of Edison Electric Illuminating stock have increased the issue from $6,500,000 to $7,923,000. Of this $1,423,000 increase $673,000 in stock was issued for the retirement of a similar amount of bonds. The balance of $750,000 was treasury stock.

Holders of the $3,250,000 five per cent. first mortgage bonds had the option of exchanging their bonds for 6 per cent. stock at par, between May 15 and June 15.

The fact that a majority did not assent is probably due to the present disturbed financial situation, which causes investors to regard a 5 per cent. first mortgage bond as a better security than a 6 per cent. stock.

We are told that the stock is earning more than 6 per cent.

Western Union was another active stock subjected to bear attacks. The highest price of the week was 82 on Monday. Through persistent pegging it sold off to 79¾, rallying with the balance of the market to 81 before the close.

In a market such as the one described it is not to be expected that there was any activity in the less active electrical securities, whose field is most strictly of an investment order.

There were few or no sales and scarcely any inquiry.

The directors of the General Electric Company, at a meeting to-day, declared the regular 6 per cent. dividend, payable August 2. Books will close July 11 and reopen August 2. This action taken in connection with the financial statement issued after the meeting, and published following, will have a tendency to terminate the bear campaign against the company.

For the four months ending May 1, 1893, the net profits of the company were	$1,391,721
Net profit for June (partly estimated)	360,000
Total	$1,751,729
Less five months accrued interest on debentures	208,333
Available for stocks	1,543,396
Less five months accrued dividends on preferred stock at 7 per cent.	$124,013
And five months accrued dividends on common stock at 8 per cent.	1,014,180
Total	1,138,193
Net surplus for five months over and above accrued interest and dividends.	405,202

The above profits are exclusive of all license and royalty stocks and other securities received since January 31.

The operation of the two companies under the consolidated management commenced on June 1, 1892. This is the first month, therefore, that an exact comparison of the operations of the General Electric Company with those of the previous year has been possible. For the first 26 days of June the output of the factories and the business of the company were about 15 per cent. more than for the same period in 1892, with a corresponding increase in net profits.

New York, June 30.

Government Telegraph Rates.

General Thomas T. Eckert, president of the Western Union Telegraph Company, has been in Washington consulting with the heads of the various departments with regard to the annual contract for government telegraphing. This matter is important enough to have been talked over at a recent Cabinet meeting in the intervals of the consultation on the financial situation. The aggregate amount paid to the telegraph company for the transmittal of official messages in the course of a year is very large, and an attempt is now being made by Postmaster-General Bissell and General Eckert to arrange a schedule of charges that will be satisfactory to all parties. The Western Union Company, a few years ago, refused to accept the rates fixed by Postmaster-General Wanamaker, but agreed to handle the government business without reimbursement until the courts could settle the points in controversy. Finally, however, as a result of the visit of Jay Gould to President Harrison, the company accepted the Wanamaker rates under protest, and their suit to recover damages is now pending.

THE ACTION OF COMPOUND DYNAMOS WHEN RUN IN PARALLEL.

(*Continued from page 253*)

resistance that the net result was a constant potential at the terminals.

The various curves of these dynamos are plotted in Fig. 8, and may be described as follows: Curve 3 gives the fall of potential or drop in volts, due simply to the fall in speed as the load on the dynamo increases, and is the same for each separately driven dynamo. Curve 4 gives the drop in volts in the total armature circuit from equalizer wire, which will be considered as a bus bar, to main bus bar, and does not include the drop in the series coils and connection to the bus bar, which is given separately in curve 5.

Curve 0 is the sum of curves 3, 4 and 5, and represents the total drop in each dynamo, when running independently, due to all reactions; while curve 1 is the sum of 3 and 4; or the total drop, if we consider the series coil as a part of the external circuit. Curves 7 and 8 show respectively the rise in voltage due to the current in the series coils of each dynamo, and it will be seen that for the same current value, dynamo No. 2 has a somewhat more powerful series coil. Curve 6, being the equal and opposite of curve 0, shows the rise in volts which each dynamo must have in order to maintain a constant potential at its terminals; and, therefore, a horizontal line cutting curve 6, as, for example, at the rated current of 45 amperes, will cut the curves 7 and 8 at points whose corresponding current values are those which will produce the required magnetizing force, and the difference between these current values and the rated current must be carried by the shunts on the series coils.

The series coils of each dynamo were adjusted to a resistance of .15 ohm, and the series coil shunt of dynamo No. 1 had a resistance of about .60 ohm, and would carry at full load about 9 amperes, leaving 36 amperes to produce the rise of 27 volts necessary to neutralize the total drop taken from curve 0. To produce the same rise in No. 2 dynamo required a shunt of about .22 ohm, carrying 18 amperes, leaving but 27 for the series coils.

These two dynamos are now in such a condition that according to the usual practice it would be perfectly proper to run them in parallel with the expectation that everything would work well; however, such is not the case, as may be seen from the curves and as was proved by the actual effects obtained.

When the two series coils, with their shunts, are thrown in parallel the total flow of current through them will divide inversely as the resistances of the four circuits, which are, as we have just seen, two series coils each of .15 ohm, one shunt of .60 ohm and one of .22 ohm. If we call the total current 100, these four circuits will carry, respectively, about 33.7, 33.7, 8.4, and 24.1, and as the total output of the two armatures may safely be 100 amperes, the above figures give the strength of current in these circuits.

At the top of Fig. 8 is a scale reading from right to left up to 100 amperes, and near the left hand side a scale reading downwards up to 30 amperes; the three inclined lines enable us to read at once the actual current in the two shunts and the two series coils for any output of the dynamos when running in parallel.

It has already been shown that each dynamo is individually capable of maintaining a constant potential at the bus bars, independently of the current flowing, and it has been stated that the dynamos will not work well in parallel. Suppose that the dynamos are connected in parallel at 220 volts, under no load and that a current of 90 amperes, which is equal to the rated load of the two dynamos, is taken from the bus bars. To find the currents in the series coils, we find under 90 amperes total output that each series coil will carry 30.4 amperes; the shunt on No. 1, 7.6 amperes, and the shunt on No. 2, 21.6 amperes.

No. 1.	No. 2.	
220.	220.	Volts at no load.
+22.5	+30.2	Rise from curves 7 and 8 at 30.4 amperes.
242.5	250.2	Total armature voltage.
	—7.7	Fall of volts due to 17 amperes, curve 1. No. 2 can deliver current producing a fall of 250.2—242.5 before No. 1 begins to act as a dynamo at all, and after that both armatures will divide the remainder, or 90—17=73, and the total drop is taken from curve 1 for one-half the difference, or 36.5 amperes.
242.5	242.5	
—16.5	—16.5	Drop with 36.5 amperes, curve 1.
226.0	226.0	Armature bus bar voltage.
—6.5	—6.5	Drop in the series coil, giving for the main bus bars 220.5 volts with an output of 36.5 amperes from dynamo No. 1, and 53.5 from No. 2.
220.5	220.5	

As an interesting example of the different degree of badness which may be produced when two individually well adjusted dynamos are run in parallel, let us suppose that these two dynamos are placed in proper alignment and one large driving pulley slipped over the ends of the shafts, as is very often done, thus making the armatures run at the same speed with the same per cent. belt slip, which will bring the resultant voltage about the same as in the previous example.

No. 1.	No. 2.	
220.	220.	Volts at no load.
22.5	+30.2	Rise from curves 7 and 8 as before.
242.5	250.2	Total armature voltage.
	—7.7	Fall of volt due to 38 amperes. Curve 4.
242.5	242.5	Dynamo No. 2 must deliver a current producing a fall of volts equal to the difference of the armature voltages before No. 1 will deliver any current. The remaining current will divide equally, producing a fall found in curve 4.
—5.2	—5.2	Fall with 26 amperes, curve 4.
237.3	237.3	
—6.5	—6.5	Drop in series coils. Curve 5.
230.8	230.8	
—11.2	—11.2	Belt slip. Curve 3.
219.6	219.6	Voltage on main bus bars with an output of 26 amperes from dynamo No 1 and 64 from No. 2.

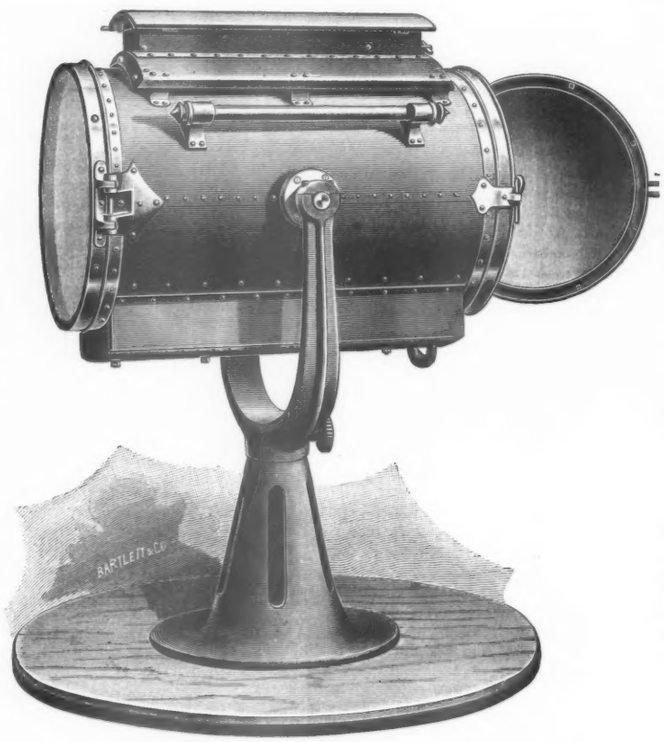
COMPARATIVE TABLE.

	No. 1. Amperes.	No. 2. Amperes.	Volts.
Separate loads.....	45.	45.	220.
Parallel.....	36.5	53.5	220.5
Parallel at same speed	26.	64.	219.6

Electric Projectors with American Lenses.

The search-light of to-day is a very differently constructed device from that offered to the public several years ago. The old affairs were constructed very clumsily, were heavy and awkward to manipulate, and required an expert to connect the different parts and pieces to make them work at all.

The Electric Construction & Supply Company, 18 Cortlandt street, New York, is now making projectors that are not only neat in appearance, but are constructed of few parts, and all the waste material is cut out, simplicity of construction and ease of manipulation being the principal characteristics. The quality of the reflecting lens is very high class, so that very little of the light is lost that is furnished by the lamp used. This company is now making these lenses in America, of different sizes, which are in every way equal to the Mangin lens or imported articles, at a very much less cost, and with this saving in manufacture, together with the saving on the duty of the imported article, they are enabled to offer their customers a projector lens at a price almost equal to the old-fashioned silvered metal reflector.



ELECTRIC CONSTRUCTION & SUPPLY COMPANY'S NEW ELECTRIC PROJECTOR, WITH AMERICAN LENS.

These lenses are so mounted in the projectors that they can be kept in a perfect condition, requiring only the exposed surface to be kept clean.

There is an opinion, gathered from the ships of war, that only imported lenses are used in this country, but the Electric Construction & Supply Company is prepared to furnish them in several sizes, to be used either automatically or with hand feed lamps.

They manufacture a search-light that is of non-magnetic metal, and is fitted with a lens projector and a balance automatic focusing arc lamp that will feed upon the angles used for signaling. This apparatus can be turned on its axis in a horizontal direction by the smallest possible power, as the bearings are anti-friction or ball bearings. It is light in weight, and the parts are made to conform to the finish and design of the finest yachts. All the connections are of good mechanical design, and wires are not exposed where abrasion can take place. A 12 inch projector of this style, highly finished in brass and copper, provided with an automatic focusing lamp, with a pilot-house attachment and every particular in detail, weighs 125 pounds. This is considered a light weight when every part is made durable and strong.

The Electric Construction & Supply Company is now installing one of these projectors on Mr. F. W. Vanderbilt's yacht, "Conqueror." Two others, operated by hand feed mechanism and passing 60 amperes of current each, have been shipped on order to Canada.

Electro-Photography.

A scheme for electro-photography, says London *Lightning*, appears in a Paris photographic journal. The fundamental idea of the method is plain enough. A copy of the negative is taken upon a gelatine film, and the film, as is known, offers an uneven surface; its plane areas correspond to the whites of the photo, while the darker parts of the latter appear more or less in relief. The film is accordingly fixed upon a cylinder, which is made to rotate by electricity at a speed of 20 revolutions per minute. A thin needle touches its surface in such a way as to describe a helical line on the cylinder, and to touch in turn every spot of the surface of the photo. Each time the needle comes upon a relief it is lifted; and as it forms part of an electric circuit, the current is weakened by this movement. The current is transmitted in the usual way along a wire to the next station. There another cylinder, covered with paraffine wax, is made to rotate at exactly the same speed, and another needle, moved by the current, precisely imitates the movements of the first. It thus engraves on wax an exact reproduction of the gelatine film, from which a typographic copy is taken in the ordinary way.

The Finest on Wheels.

AN EXPERIENCED TRAVELER EULOGIZES THE FINEST TRAIN IN THE NORTHWEST.

Hon. T. B. Bryan, of Chicago, vice-president of the World's Fair Commission, and a man of national reputation, in his address before the Real Estate Exchange, of Minneapolis, at their banquet at the West Hotel on the evening of February 3, made some pertinent suggestions that the people of Minneapolis will do well to follow. He cited the fact that for the last 40 years he has been traveling constantly, and had probably ridden on every first-class train in the world; that he paid his fare like a man on his trip from the Windy City to the Flour City, and that he "intended giving no free puff" for the railroad he patronized, but that he felt a truthful statement from his lips was opportune, and so he wanted the gentlemen gathered around the board to know that he had never enjoyed such luxury, comfort or pleasure in any train as he had on the "Northwestern Limited" the night previous.

"I cannot see how this wonderful train could be improved," said he, "for it is perfect now. It is the paragon of railroad architecture, and it is perfect as man's fingers can make it. No king, no queen, no potentate—I venture the statement, gentlemen, that not even the Czar of all the Russias could conceive to be built a more luxurious or complete a train than this one of which I speak. When our visitors from across the water see such luxury on wheels as that train between Chicago and as far remote a city to them as Minneapolis, I imagine they will hold up their hands in very surprise. They will be astounded to discover such luxurious appointments on wheels in the 'far West,' ornate and elegant enough for royalty itself."

Mr. Bryan also supplemented this remark with the comment that it was unfortunate that Eastern people, who had exaggerated ideas of our Western civilization, could not compare the luxury of traveling in the West on such a train as the "Northwestern Limited" with the accommodations found in the East. He had never seen such railroad magnificence in the United States or anywhere else, and he was sure no one else had either. The "Northwestern Limited" was a splendid drawing attraction for Minneapolis in more ways than one to induce World's Fair visitors to enter her gates next summer. —*The Minneapolis Times*, February 18, 1893.

While the equipment and train service of the Northwestern Line between Chicago and St. Paul and Minneapolis fully merits the lavish praise accorded by Mr. Bryan, the fact should not be lost sight of that the through car lines of this great railway system also reach nearly every important city and summer resort west and northwest of Chicago, including Milwaukee, Fond du Lac, Green Bay, Marquette, Duluth, Superior, Ashland, La Cross, Winona, Council Bluffs, Omaha, Sioux City, Deadwood, Denver, Portland and San Francisco.

To all of the above mentioned cities, as well as to intermediate points, the Northwestern Line offers unequaled facilities for the safe, speedy and comfortable transportation of passengers, among the attractive features of its equipment being solid vestibule trains, Wagner and Pullman sleeping cars, private compartment cars, buffet, smoking and library cars, free reclining chair cars, luxurious parlor cars and superb dining cars.

GENERAL NOTES.

The Electric Railway Company, of Lynchburg, Va., has ordered from the Westinghouse Company new generators sufficient to operate their plant.

Arrangements are being made by the employés of the General Electric Company, at Schenectady, N. Y., for a grand field day, to be held at Bellevue Park and the Campbell race track on the Fourth of July.

Some bright people are beginning to realize that the long distance telephone system is interfering with railroad travel, as boards of directors and others in business can talk to each other from a distance without the necessity of being visibly present.

Plans for a vigorous prosecution of work on the proposed Washington and Baltimore Interurban Electric Railway were discussed at a meeting in Baltimore last week. It was attended by a number of Baltimore stockholders of the company, also by the Philadelphia millionaire capitalists and promoters, P. A. B. Widener, W. M. Elkins and Thos. Dolan.

On Light and Other High Frequency Phenomena.

A LECTURE DELIVERED BEFORE THE FRANKLIN INSTITUTE, AT PHILADELPHIA, FEBRUARY 24, 1893, AND BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AT ST. LOUIS, MO., MARCH 1, 1893.

BY NIKOLA TESLA.

(*Continued from page 239.*)

Later a number of these tubes with one or more wires were prepared, each showing this result. The effect was best noted when the striated discharge occurred in the tube, but was also produced when the striæ were not visible, showing that, even then, the gas in the tube was not of uniform density. The position of the striæ was generally such that the rarefactions corresponded to the places of incandescence or greater brightness on the wire w. But in a few instances it was noted that the bright spots

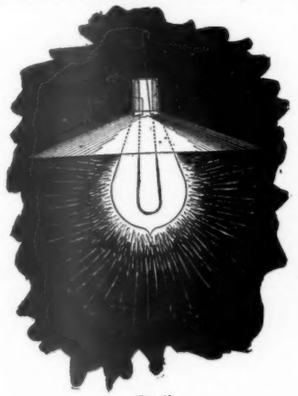


Fig. 24

TESLA LECTURE.—UTILIZING THE HEATING EFFECT OF CONDUCTION CURRENT AND BOMBARDMENT.

on the wire were covered by the dense parts of the striated discharge as indicated by *l* in Fig. 23, though the effect was barely perceptible. This was explained in a plausible way by assuming that the convection was not widely different in the dense and rarefied places, and that the bombardment was greater on the dense places of the striated discharge. It is, in fact, often observed in bulbs that under certain conditions a thin wire is brought to higher incandescence when the air is not too highly rarefied. This is the case when the potential of the coil is not high enough for the vacuum, but the result may be attributed to many different causes. In all cases this curious phenomenon of incandescence disappears when the tube, or rather the wire, acquires throughout a uniform temperature.

Fig. 25

TESLA LECTURE.—ILLUSTRATING LATERAL DIFFUSION.

Disregarding now the modifying effect of convection, there are then two distinct causes which determine the incandescence of a wire or filament with varying currents; that is, conduction current and bombardment. With steady currents we have to deal only with the former of these two causes, and the heating effect is a minimum, since the resistance is least to steady flow. When the current is a varying one, the resistance is greater, and hence the heating effect is increased. Thus, if the rate of change of the current is very great, the resistance may increase to such an extent that the filament is brought to incandescence with inappreciable currents; and we are able to take a short and thick block of carbon or other material and bring it to bright incandescence with a current incomparably smaller than that required to bring to the same degree of incandescence an ordinary thin lamp filament with a steady or low frequency current. This result is important, and illustrates how rapidly our views on these subjects are changing and how quickly our field of knowledge is extending. In the art of incandescent lighting, to view this result in one aspect only, it has been commonly considered as an essential requirement for practical success that the lamp filament should be thin and of high resistance. But now we know that the resistance to the steady flow of the filament does not mean anything; the filament might as well be short and thick; for if it be immersed in

Fig. 26

TESLA LECTURE.—INCANDESCENCE OF A SOLID.

rarefied gas it will become incandescent by the passage of a small current. It all depends on the frequency and potential of the currents. We may conclude from this that it would be of advantage, so far as the lamp is considered, to employ high frequencies for lighting, as they allow the use of short and thick filaments and smaller currents.

If a wire or filament be immersed in a homogeneous medium, all the heating is due to true conduction current; but if it be inclosed in an exhausted vessel, the conditions are entirely different. Here the gas begins to act, and the heating effect of the conduction current, as shown in many experiments, may be very small compared with that of the bombardment. This is especially the case if the circuit is not closed and the potentials, of course, very high. Suppose a fine filament, inclosed in an exhausted vessel, be connected with one of its ends to the terminal of a high tension coil, and with its other end to a large insulated plate. Though the circuit is not closed, the filament, as I have before shown, is brought to incandescence. If the frequency

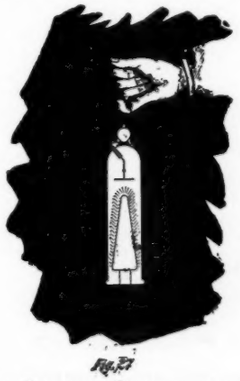


Fig. 27

TESLA LECTURE.—PHOSPHORESCENCE.

and potential be comparatively low, the filament is heated by the current passing through it. If the frequency and potential, and principally the latter, be increased, the insulated plate need be but very small, or may be done away with entirely; still the filament will become incandescent, practically all the heating being then due to the bombardment. A practical way of combining both the effects of conduction current and bombardment is illustrated in Fig. 24, in which an ordinary lamp is shown provided with a very thin filament which has one of the ends of the latter connected to a shade serving the purpose of the insulated

Fig. 28

TESLA LECTURE. — INCANDESCENCE OR PHOSPHORESCENCE OF RAREFIED GAS.

plate, and the other end to the terminal of a high tension source. It should not be thought that only rarefied gas is an important factor in the heating of a conductor by varying currents, but gas at ordinary pressure may become important, if the potential difference and frequency of the currents are excessive. On this subject I have already stated that when a conductor is fused by a stroke of lightning the current through it may be exceedingly small, not even sufficient to heat the conductor perceptibly were the latter immersed in a homogeneous medium.

From the preceding it is clear that, when a conductor of high resistance is connected to the terminals of a source of high frequency currents of high potential, there may occur considerable dissipation of energy, principally on the ends of the conductor, in consequence of the action of the gas surrounding the conductor. Owing to this, the current through a section of the conductor at a point midway between its ends may be much smaller than through a section near the ends. Furthermore, the current passes principally through the outer portions of the conductor, but this effect is to be distinguished from the skin effect as ordinarily interpreted, for the latter would

Fig. 29

TESLA LECTURE.—LUMINOSITY OF GAS AT ORDINARY PRESSURE, ILLUSTRATING FOUR KINDS OF LIGHT EFFECTS PRODUCED BY HIGH FREQUENCY CURRENTS OF HIGH POTENTIAL.

or should occur in a continuous incompressible medium. If a great many incandescent lamps are connected in series to a source of such currents, the lamps at the ends may burn brightly, whereas those in the middle may remain entirely dark. This is due principally to bombardment, as before stated. But even if the currents be steady, provided the difference of potential is very great, the lamps at the ends will burn more brightly than those in the middle. In such case there is no rhythmical bombardment, and the result is produced entirely by leakage. This leakage or dissipation into space when the tension is high is considerable when incandescent lamps are used, and still more considerable with arcs, for the latter act like flames. Generally, of course, the dissipation is much smaller with steady than with varying currents.

I have contrived an experiment which illustrates in an interesting manner the effect of lateral diffusion. If a very long tube is attached to the terminal of a high

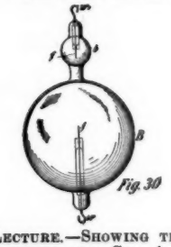


Fig. 30

TESLA LECTURE.—SHOWING THE EFFECT OF CONFINING THE GAS AROUND THE ELECTRODE.

frequency coil, the luminosity is greatest near the terminal and falls off gradually toward the remote end. This is more marked if the tube is narrow.

A small tube about one-half inch in diameter and 12 inches long, Fig. 25, has one of its ends drawn out into a fine fibre *f* nearly three feet long. The tube is placed in a brass socket T which can be screwed on the terminal T_1 of the induction coil. The discharge passing through the tube first illuminates the bottom of the same, which is of comparatively large section; but through the long glass fibre the discharge cannot pass. But gradually the rarefied gas inside becomes warmed and more conducting, and the discharge spreads into the glass fibre. This spreading is so slow that it may take half a minute or more until the discharge has worked through up to the top of the glass fibre, then presenting the appearance of a strongly luminous thin thread. By adjusting the potential at the terminal the light may be made to travel upward at any speed. Once, however, the glass fibre is heated the discharge breaks through its entire length instantly. The interesting point to be noted is that, the higher the frequency of the currents, or in other words the greater relatively the lateral dissipation, at a slower rate may the light be made to propagate through the fibre. This experiment is best performed with a highly exhausted and freshly made tube. When the tube has been used for some time the experiment often fails. It is possible that the gradual and slow impairment of the vacuum is the cause. This slow propagation of the discharge through a very narrow glass tube corresponds exactly to the propagation of heat through a bar warmed at one end. The quicker the heat is carried away laterally the longer time it will take for the heat to warm the remote end. When the current of a low frequency coil is passed through the fibre from end to end, then the lateral dissipation is small, and the discharge instantly breaks through almost without exception.

After these experiments and observations, which have shown the importance of the discontinuity or atomic structure of the medium, and which will serve to explain, in a measure at least, the nature of the four kinds of light effects producible with these currents, I may now give you an illustration of these effects. For the sake of interest I may do this in a manner which to many of you might be novel. You have seen before that we may now convey the electric vibration to a body by means of a single wire or conductor of any kind. Since the human frame is conducting I may convey the vibration through my body.

First, as in some previous experiments, I connect my body with one of the terminals of a high tension transformer, and take in my hand an exhausted bulb which contains a small carbon button mounted upon a platinum wire leading to the outside of the bulb, and the button is rendered incandescent as soon as the transformer is set to work (Fig. 26). I may place a conducting shade on the bulb, which serves to intensify the action, but it is not necessary. Nor is it required that the button should be in conducting connection with the hand through a wire leading through the glass, for sufficient energy may be transmitted through the glass itself by inductive action to render the button incandescent.

Next I take a highly exhausted bulb con-

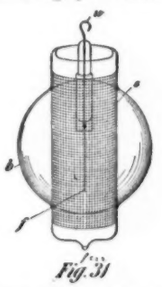


Fig. 31

TESLA LECTURE.—SHOWING THE INEFFICIENCY OF A METAL SCREEN.

taining a strongly phosphorescent body, above which is mounted a small plate of aluminum on a platinum wire leading to the outside, and the currents flowing through my body excite intense phosphorescence in the bulb, Fig. 27. Next, again, I take in my hand a simple exhausted tube, and in the same manner the gas inside the tube is rendered highly incandescent or phosphorescent, Fig. 28. Finally I may take in my hand a wire—bare or covered with thick insulation, it is quite immaterial; the electric vibration is so intense as to cover the wire with a luminous film, Fig. 29.

A few words must now be devoted to each of these phenomena. In the first place, I will consider the incandescence of a button or of a solid in general, and dwell upon some facts which apply equally to all these phenomena. It was pointed out before that when a thin conductor, such as a lamp filament, for instance, is connected with one of its ends to the terminal of a transformer of high tension, the filament is brought to incandescence partly by a conduction current and partly by bombardment. The shorter and thicker the filament, the more important becomes the latter, and, finally, reducing the filament to a mere button, all the heating must practically be attributed to the bombardment. So in the experiment before shown, the button is rendered incandescent by the rhythmical impact of freely movable small bodies in the bulb. These bodies may be the molecules of the residual gas, particles of dust or lumps torn from the electrode; whatever they are, it is certain that the heating of the button is essentially connected with the pressure of such freely movable particles, or of atomic matter in general in the bulb. The heating is the more intense the greater the number of impacts per second and the greater the energy of each impact. Yet the button would be heated also if it were connected to a source of steady potential. In such a case electricity would be carried

away from the button by the freely movable carriers or particles flying about, and the quantity of electricity thus carried away might be sufficient to bring the button to incandescence by its passage through the latter. But the bombardment could not be of great importance in such case. For this reason it would require a comparatively very great supply of energy to the button to maintain it at incandescence with a steady potential. The higher the frequency of the electric impulses the more economically can the button be maintained at incandescence. One of the chief reasons why this is so, is, I believe, that with impulses of very high frequency there is less exchange of the freely movable carriers around the electrode and this means that in the bulb the heated matter is better confined to the neighborhood of the button. If a double bulb as, illustrated in Fig. 30, be made, comprising a large globe, B, and a small one, *b*, each containing as usual a filament, *f*, mounted on a platinum wire, *w* and w_1, it is found, that if the filaments, *f f*, be exactly alike, it requires less energy to keep the filament in the globe, *b*, at a certain degree of incandescence than in the large globe, B. This is due to the confinement of the movable particles around the button. In this case, it is also ascertained, that the filament in the small globe *b* is less deteriorated when maintained a certain length of time at incandescence. This is a necessary consequence of the fact that the gas in the small bulb becomes strongly heated, and therefore a very good conductor, and less work is then performed on the button, since the bombardment becomes less intense as the conductivity of the gas increases. In this construction, of course, the small bulb becomes very hot, and when it reaches an elevated temperature the convection and radiation on the outside increase. On another occasion I have shown bulbs in which this drawback was largely avoided. In these instances a very small bulb, containing a refractory button, was mounted in a large globe, and the space between the walls of both was highly exhausted. The outer large globe remained comparatively cool in such constructions. When the large globe was on the pump and the vacuum between the walls maintained permanent by the continuous action of the pump, the outer globe would remain quite cold while the button in the small bulb was kept at incandescence. But when the seal was made, and the button in the small bulb maintained incandescent some length of time, the large globe too would become warmed. From this I conjectured that if vacuous space (as Professor Dewar finds) cannot convey heat, it is so merely in virtue of our rapid motion through space or, generally speaking, by the motion of the medium relatively to us, for a permanent condition could not be maintained without the medium being constantly renewed. A vaccum cannot, according to all evidence, be permanently maintained around a hot body.

In these constructions, before mentioned, the small bulb inside would, at least in the first stages, prevent all bombardment against the outer large globe. It occurred to me then to ascertain how a metal sieve would behave in this respect, and several bulbs, as illustrated in Fig. 31, were prepared for this purpose. In a globe, *b*, was mounted a thin filament, *f* (or button), upon a platinum wire, *w*, passing through a glass stem and leading to the outside of the globe. The filament *f* was surrounded by a metal sieve, *s*. It was found in experiments with such bulbs that a sieve with wide meshes apparently did not in the slightest affect the bombardment against the globe *b*. When the vacuum was high, the shadow of the sieve was clearly projected against the globe, and the latter would get hot in a short while. In some bulbs the sieve was connected to a platinum wire sealed in the glass. When this wire was connected to the other terminal of the induction coil (the electromotive force being kept low in this case) or to an insulated plate, the bombardment against the outer globe *b* was diminished. By taking a sieve with fine meshes the bombardment against the globe *b* was diminished, but even then, if the exhaustion was carried very far, and when the potential of the transformer was very high, the globe *b* would be bombarded and heated quickly, although no shadow of the sieve was visible, owing to the smallness of the meshes. But a glass tube or other continuous body mounted so as to surround the filament did entirely cut off the bombardment, and for a while the outer globe *b* would remain perfectly cold. Of course, when the glass tube was sufficiently heated, the bombardment against the outer globe could be noted at once.

(To be continued.)

Increase of Capital.

The Siemens & Halske Electric Company, of America, on January 24, increased its capital stock to $1,000,000. The increased stock was all taken at par by the present stockholders.

The company is doing an extensive business, chiefly in the manufacture of large generators for long distance work.

The Peck Double-Deck Boiler.

We represent in the accompanying illustrations two views of the Peck double deck boiler, manufactured by C. C. Peck, of Rochester, N. Y. In competing with other boiler manufacturers at the present day one must indeed have a good article, maintain the high standard of his factory, and give the purchasing public a chance to know of his wares. This is what is being done by the company manufacturing these boilers, who claim many advantages over the other styles, and among the many features stated may be mentioned the following few:

The provision for continuous rapid circulation of all the boiler water in a circuit, or in one direction, so that there are no opposing currents, and the boiler structure is kept at a uniform temperature throughout. This avoids the great evils of unequal expansion and contraction, and gives highest value to each square foot of heating surface. It further provides for carrying away from said surface the steam bubbles as fast as formed, and liberating them quietly from the water at the surface of the latter, thus avoiding foaming and priming, and insuring dry steam.

The deposit of solid matter (precipitated from the boiler water) on surfaces not exposed to direct contact with the fire, or gases of combustion. The deposition of the solid constituents of the water is found to be in the drum, or in the bottom of the annular water passage around the lower shell, at which latter point the blow-off pipe is connected. As the solids are not baked on to the heating surfaces, they remain in a soft state, and are easily washed out with a hose.

The perfect control of boiler action, furnace temperature and condition of fire, by means of mechanically induced draft, furnace design and arrangement of dampers.

High evaporative efficiency per pound of coal burned, and per square foot of heating surface, due to rapid circulation of boiler water, high furnace temperature, and nearly perfect combustion; and the employment of smaller tubes than are ordinarily used in stationary boilers. The design of boiler, setting and draft arrangements provides for evaporative efficiency similar to that of the boiler of a locomotive, while at the same time securing fuel economy, which cannot be realized in a locomotive boiler. It combines the good operative points in both the locomotive and the water tube types of boilers, while possessing some further advantages.

The design permits concentration of power, which tends not only to economy of space, but economy of fuel, and easy and convenient management. The boiler is divided into two shells of not far from equal size, so designed as not to require stays or braces. The tubes are two inches or 2¼ inches in size. The fire or furnace gases do not touch the shells, and the circulation is so rapid that the whole boiler structure is kept at nearly the same temperature, making it safer to use higher pressures and larger shells than in the case of ordinary boilers in which the furnace gases impinge against the shells.

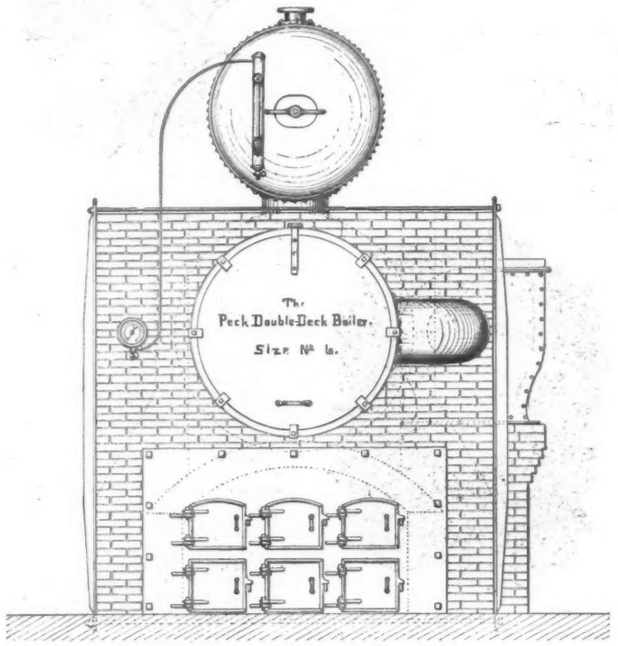


FIG. 2.—FRONT VIEW OF PECK DOUBLE-DECK BOILER.

The same factor of safety in this boiler has more value than in stationary boilers in which the shells are brought in contact with the fire, and in which the circulating currents of water are mixed in such a way as to *oppose* each other; but in no case will a smaller safety factor be used, and this factor will be increased as high as may be desired to suit the ideas of those employing the boiler in large buildings and where great amounts of power are required—the boiler being eminently adapted to the requirements of electric light and power stations, and in large manufactories where it is necessary to have dry steam under all circumstances, and also capacity for quickly responding to sudden and large demands for extra quantities of steam.

At the rated power the boiler has an unusually large margin of capacity, it being easy to run it one-third higher. In a recent ten-hour test made by an expert and assistant employed by other parties, one of the boilers was run at the rate of 85 per cent. above its rating, and while working in this way the operation was very steady, and the steam showed only $\frac{7}{10}$ of one per cent. moisture.

As the shells are not exposed to fire action, and as the whole boiler structure is kept at practically the same temperature, there is small liability to leaks, and the life of the boiler and ability to endure forcing without injury (largely on account of rapid circulation and induced draft) will be found great.

With the exception of the tubes, the boiler is constructed thoroughly of the best makes of steel, and no cast-iron enters into its composition.

Fig. 1, shows the side view of the setting of a boiler, the principal object of such an arrangement being to avoid contact of the boiler shell with the furnace gases, and the provision of a roomy and at the same time highly heated combustion chamber to ensure complete combustion of said gases before entering the cooling surface of the tubes, and to prevent cold air drafts from impinging upon the shell.

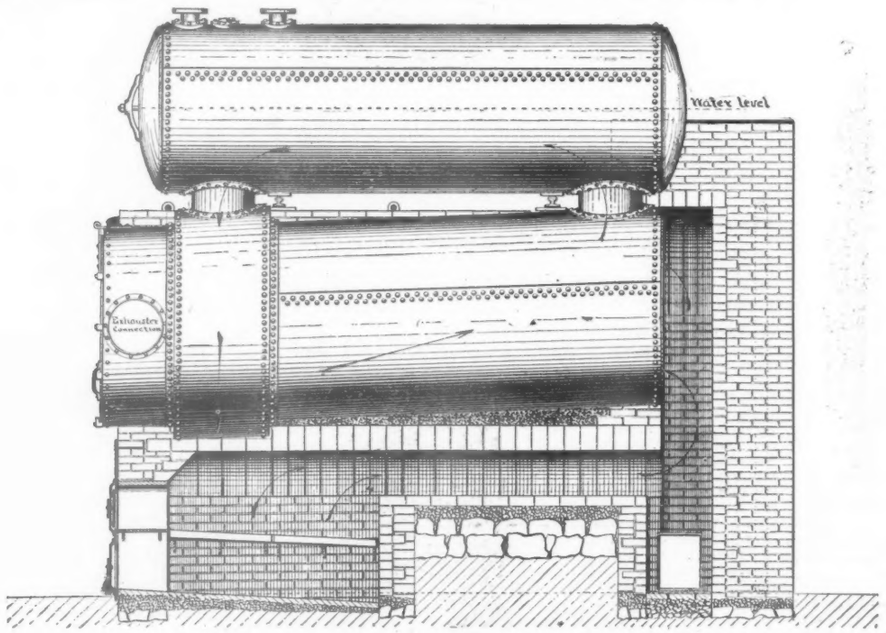


FIG. 1.—SIDE VIEW OF PECK DOUBLE-DECK BOILER.

In the drawing, the arrows feathered on one side indicate the course taken by the furnace gases; and arrows feathered on both sides show the direction of water circulation.

The cost of the double-deck boiler, including exhauster and its engine, setting and smoke-stack will compare favorably with that of other well-proportioned, well-made and well-set boilers. Fig. 2 shows the front view of the same boiler.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week.

New Electric Railways.

BAYONNE, N. J.—The Bayonne City Rapid Transit Company is an applicant for a franchise to build an electric railway through nine miles of streets.

HOLBROOK, MASS.—Parties holding a franchise for an electric street railway through Braintree have applied to the selectmen for a franchise.

HOUSTON, TEX.—The city council has granted right-of-way for an electric railway which is to run to the town of Harrisburg, a distance of five miles.

PITTSBURGH, PA.—The Pittsburgh, Crafton and Mansfield Street Railway Company has been incorporated with a capital of $500,000. The company will build and operate an electric railway from Pittsburgh to Mansfield and Crafton.

BRIDGETON, N. J.—The South Jersey Traction Company has come into possession of all the franchises and property of the Bridgeton Rapid Transit Company and the Bridgeton and Millville Turnpike Company. The officers of the Traction Company are George Wood, president, Millville; Richard W. Clay, vice-president, and Walter H. Bacon, secretary and treasurer, Bridgeton.

Electric Light and Power.

ERIE, PA.—The Merchants' and Manufacturers' Electric Light, Heat and Power Company has been incorporated with a capital of $50,000.

WINCHESTER, MASS.—The town has voted to accept the act giving municipalities the right to establish their own electric light plants.

RIVERSIDE, CAL.—The Riverside Electric Company, capital, $100,000, has been incorporated to generate and distribute electricity. Incorporators, Frederick Carter, George L. Bush and others.

SPRINGFIELD, MINN.—The proposition to bond the city for an electric light plant has been carried by a large majority.

TRENTON, N. J.—The Empire Light Company; capital, $100,000. Incorporators, Arthur J. Cleveland and Altamont de Cordovan, of New York city; Leroy S. Lewis, of Springfield, Mass.; Harris B. Mitchell, of Malden, Mass.; and John P. Craighead, of Jersey City. The company will manufacture and sell lighting and heating apparatus of all kinds.

NEWARK, N. J.—The Young-Moskowitz Railway Car Electric Lighting Company; capital, $1,000,000, of which $1,000 is paid up. Incorporators, Chas. L. Sterling, Frank C. O'Reilly, Leon D. Adler, James F. Connelly, Joseph Lowenberg, Morris Moskowitz, Samuel Young and W. Hopper. The company will carry on the business of lighting railway cars by electricity, manufacture and deal in electric and railway appliances and deal in electric patents.

WAKEFIELD, MASS.—Stoneham, Wakefield and Reading propose to establish a joint municipal electric light plant to light the three towns. The town of Wakefield will probably have to buy the electric plant of the Wakefield Gas Company, in which case the three towns will make some mutual arrangement to be supplied from this plant.

KENOSHA, WIS.—The Kenosha Electric Light Company; capital, $15,000. Incorporators, E. G. Hazelton, Lewis Bain and Urban J. Lewis.

New Telephone Company.

CHICAGO, ILL.—The Baldwin Adjustable Telephone Company; capital, $2,000,000. Incorporators, George A. Waddell, Henry L. Baldwin and Florien P. Goss.

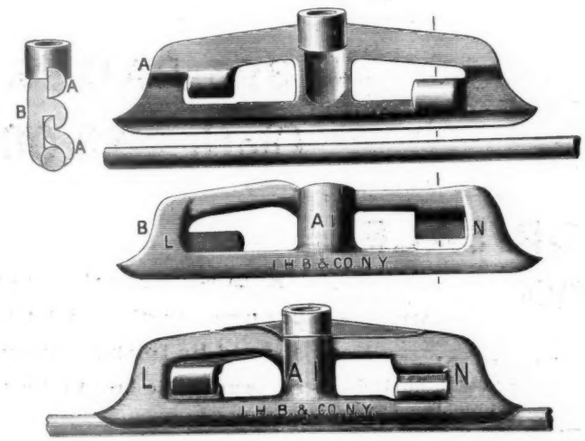


FIG. 1.—LAIN'S IMPROVED MECHANICAL CLAMPS FOR OVERHEAD ELECTRIC RAILWAY CONSTRUCTION.

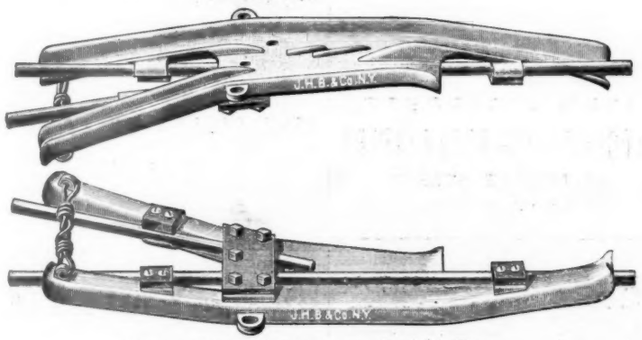


FIG. 2.—LAIN'S NON-SPARKING TROLLEY FROGS.

Some Novelties in Trolley Appliances.

J. H. Bunnell & Company, of New York city, are selling a new line of trolley fixtures which are the invention of David E. Lain, Yonkers, N. Y. Several of these are novel in construction and a brief description of them is here given:

Fig. 1 shows Lain's improved mechanical clamp for suspending the trolley wire. This clamp is made in malleable iron and consists of two essentially similar parts, each having a groove near its lower edge for the trolley wire, and also provided with interlocking lugs, the faces of which are inclined at a small angle with the grooves. These parts are so proportioned that when placed facing but not registering with each other on the wire the lugs will interlock, and as the parts are driven nearer and nearer to opposition the inclined faces of the interlocking lugs clamp more and more firmly on the wire. A great clamping force is thus obtained which originates from points near the ends where it is most needed.

The strength of the material of which these clamps is made is such that they are ground down sufficiently thin along the lower edges to provide an uninterrupted path for the trolley wheel along the under side of the wire and yet firmly secure the wire. Another lug on one of the parts is tapped for the screw on the indicator bell, and this screw enters sufficiently far below this lug to lock the other part in its place. These clamps are supplied tapped to fit any insulator.

Fig. 2 shows Lain's improved non-sparking trolley frog. The novelty in this frog consists in the form of its approaches, the floor of which are extensions of the central floor of the frog sufficiently inclined upward so that one of the flanges of the trolley wheel is the first to strike the approach, and it is gradually depressed until it is below the wire, when it may cross the central portion of the floor of the frog on its flanges, and the sparking which often occurs between the wire and the wheel when the wheel groove enters on the inclined rib, as usually constructed, is avoided.

Fig. 3 shows Lain's new adjustable crossing. It possesses all the notable non-sparking qualities of the Lain frog. It is very light, neat and simple.

Fig. 4 illustrates Lain's section insulator, which combines the best features of the two most usual types. A strong piece of fibre is provided at each end with a brass casting, suitably shaped for attachment to the end of the trolley wire. Each of these castings is provided with a strong screw clamp for connecting in the feeder wires. And the break between the castings and the fibre is rendered less sudden by four short blocks of brass, separated by short spaces and insulated from each other. Several layers of mica are placed between these blocks and the fibre in order to protect it from the sparking incident to the interruption of the current. The spark is thus reduced in destructive effect, and is borne by the metal rather than by the fibre. And the long space of unbroken insulation in the middle of the device insures reliable insulation.

Fig. 5 shows Lain's screw clamp bridle and anchor ear. The trolley wire passes through a deep groove in a brass ear and is securely clamped in the bottom of the same by means of a screw clamp, the cap of which has projecting arms that bend downward on either side as far as the horizontal plane of the wire. These arms afford places for attaching the guy wires at points in the horizontal plane of the trolley wire. Thus the strain of these wires does not deflect the trolley wire out of the horizontal plane. And since the bridle is attached by screw clamps it is quickly placed in position and as easily moved when so desired.

On some of these devices Mr. Lain has already obtained patents, and the novel features of the others are subjects of applications now in the patent office.

FIG. 3.—LAIN'S NEW ADJUSTABLE CROSSING.

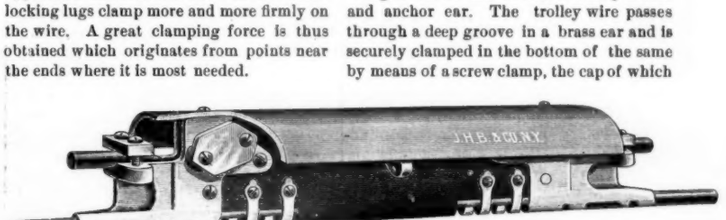


FIG. 4.—LAIN'S SECTION INSULATOR OR TROLLEY BREAK.

FIG. 5.—LAIN'S PERFECTED BRIDLE.

The West River Telephone Company has been organized at Brattleboro, Vt., with these officers: general manager, C. C. Fitts; local managers, T. P. Barber, W. F. Gleason, M. Underwood, H. N. Fitts; treasurer, J. C. Robinson. A line will be constructed from West Wardsboro through Jamaica to West Townshend.

KINDRED INTERESTS

A. L. Ide & Son, manufacturers of the "Ideal" engine, at Springfield, Ill., contemplate removing their plant to Des Moines, Ia.

Henry R. Worthington, 86 and 88 Liberty street, New York, is sending out a very interesting descriptive pamphlet, giving particulars of the various Worthington pumping engine exhibits at the World's Fair.

The W. S. Hill Electric Company, 133 Oliver street, Boston, Mass., put before the electrical field a very praiseworthy line of switches and rheostats, which are fully illustrated and described in a new catalogue just issued.

Otis Brothers & Company, 38 Park Row, New York, have sent out a very handsome and artistic catalogue describing the Otis electric pump. Any one interested in electric pumping apparatus is advised to write for one of these catalogues.

Lambert Brothers, 151 Camp street, New Orleans, La., plumbers and gas fitters, have opened an electrical department in connection with their business. They solicit catalogues and correspondence with electrical manufacturers and supply houses.

The Carpenter Enamel Rheostat Company, Bridgeport, Conn., have issued a new catalogue describing and illustrating new types of their novel resistance devices. Every electrical man should see a copy of this catalogue, which can be had upon request.

The Fort Wayne Electric Company's business is exceptionally large and prosperous. The sales of arc lighting apparatus for the first five months of 1893 aggregate 6,866 lamp capacity (lamps, dynamos and station fittings), as compared with 4,965 for same period in 1892, and 4,195 in 1891.

The New Machine Shop of the Coe Brass Manufacturing Company will be 40 feet wide and 300 feet long, two stories high. The building is designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., and will be covered with their patent anti-condensation corrugated iron roofing

To the Kerite Company the ELECTRICAL REVIEW is indebted for a very handsomely mounted paper weight made of a section of armored cable. Mr. W. R. Brixey, of 203 Broadway, the manufacturer of these cables, is enjoying a visit to the World's Fair, where he has a very interesting exhibit, recently illustrated in the REVIEW.

The Standard Paint Company, New York, has issued a neat little pamphlet describing the well known electrical compounds which it manufactures. The company also cordially invites all its friends to visit its World's Fair exhibit in the southeast gallery of the Electricity Building. Its exact location is section T, space 20, catalogue 157, group 126, class 769.

The Massachusetts Chemical Company, Boston, manufacturers of the well known Insullac, report an increased sale of their material, notwithstanding the general depression of business. They have already begun to ship in considerable quantities to European ports, and state that the managers of 12 of the largest street railway companies in this country have issued orders that no new motors will be accepted by them unless they are insulated with Insullac.

The Baltimore and Ohio Railroad Company have just issued a neat little book under the caption of "World's Fair, *via* Baltimore and Ohio Railroad," containing a description of the road and points of interest along the line, fully illustrated. It also contains a description of the prominent buildings at the World's Fair, and maps showing the location of hotels near the grounds, as well as all the hotels, railroad stations and theatres in the city proper. Copies may be had by applying to the Baltimore and Ohio ticket offices, 172, 261, 415, 1,140 Broadway, New York, and 344 Fulton street, Brooklyn. In ordering by mail, enclose four cents for postage.

It is Rumored that for some time past the General Electric Company had been considering the advisability of establishing a private printing plant, where the concern's printing could be done. This step has now been decided upon, and will no doubt save the company thousands of dollars. The bureau of information is to be merged with this department, and it is to be called the bureau of printing. All the printing of the General Electric Company will be done by that department. The lighting supply departments and the railway supply departments, it is thought, will also be merged into one department, but there are so many rumors in circulation as to changes, etc., that this could not be confirmed. One rumor had it that the offices would certainly be moved to New York very soon.

A Quaint Club Outing.

There are no pleasanter organizations in the metropolis than the one known by the novel title of Quaint Club. Its membership consists largely of newspaper and railroad men who meet once a month in the cool season to enjoy the sunshine of life, and occasionally during the heated term to enjoy a mountain or water trip.

On Saturday, June 24, about 25 members of the Quaint Club, the membership of which is restricted to 50, visited Newport to remain over Sunday. The famous Fall River Line placed its highly enjoyable service at the disposal of the Quaints, and the Ocean House at Newport opened its hospitable doors and spacious and flower-bedecked verandas to the visitors from New York. General Passenger Agent George L. Connor, and his handsome assistant, Mr. O. H. Taylor, saw that every traveler was made happy on the Fall River boat, with the most comfortable staterooms and most delectable meals.

Col. John G. Weaver, proprietor of the Ocean House, welcomed the party on their arrival at Newport, Sunday morning at 5.30 o'clock, and gave them the freedom of the city and of his hotel, and at 5 o'clock Sunday evening gave a 13-course dinner which would have made the *chefs* of the finest hotels in New York and Paris look to their laurels.

The trip over and back was a particularly joyous one, and the lively spirits, including Marshall P. Wilder, "Mickey Finn," W. S. Rodie, James Elverson, Jr., Julius Chambers and Major Tremper, assisted with song and story in making the occasion one long to be remembered. Major Tremper, who is the owner of the Tremper House, a popular Catskill hotel, is known as the "deacon." On the occasion of his passing the contribution plate the first time in his church, 17 blue chips showed up when the plate was emptied. The contributors afterwards claimed that the Major was the first deacon who understood the value of blue chips.

Hearty and sincere votes of thanks were tendered to the Fall River Line and its capable and popular officers, Messrs. Connor and Taylor; to Col. Weaver of the Ocean House, and a telegram of regret for his absence through illness was sent to president Geo. H. Daniels. The party returned to New York City the Monday morning following and those who felt so disposed resumed their work.

Among the members of the party was the indefatigable secretary, C. A. Barattoni, and H. C. Blye, Julius Chambers, Geo. L. Connor, James Elverson, Jr., Russell B. Harrison, J. D. Hashagen, F. B. Hibbard, E. G. Lemon, J. M. Nagle, Chas. W. Price, Dr. Chas. J. Perry, E. J. Richards, J. Morton Riggs, W. S. Rodie, L. L. Seaman, E. H. Talbott, Major J. H. Tremper, James B. Townsend and Marshall P. Wilder.

The Hammond Insulator.

The Hammond Cleat and Insulator Company, whose porcelain cleat was illustrated and described in these columns a short time ago, have recently put a new insulator on the market, which has created a very favorable impression on the trade since its first appearance.

Like the cleat, it is made of the finest grade of glazed porcelain and is extremely simple in its construction and application, and in

THE HAMMOND INSULATOR.

connection with the cleat, affords the easiest and quickest method of wiring.

Our illustration offers a very clear idea of the way it is applied, and those who have once used it recommend it in the strongest terms.

The Hammond Company, whose headquarters are at No. 15 Custom House street, Boston, Mass., are the manufacturers, and will furnish samples and prices upon application. They report that large orders are coming in almost daily, and that they are being taken care of promptly.

FOR SALE.

NEW DYNAMO. T.-H. make, 110 volts. Capacity: 450 lights of 16 candle-power. It has **NEVER** been run. For price and particulars, address,

C. S. M.,
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